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LEAN, TEAM AND PSYCHOSOCIAL FACTORS

A LONGITUDINAL INVESTIGATION AT A SWEDISH HOSPITAL

Waqar Ulhassan

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A Longitudinal Investigation at a Swedish Hospital

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ABSTRACT

Background: As health care struggles to meet increasing demands with limited resources, Lean Management is becoming a popular management approach. More is known about operational aspects of Lean application than about the socio-technical aspects such as how Lean interacts with teamwork and the psychosocial work environment. It is also unclear why and how organizations adopt Lean.

Aim: This project, including four sub-studies, aimed to identify the antecedents and characteristics of Lean implementation at a Swedish Hospital. The research for this thesis also examined longitudinal changes in certain socio-technical aspects of Lean (i.e., teamwork and the psychosocial work environment).

Methods: The thesis used a case study design (with data from interviews, observations and documents) to examine information about the Lean implementation at two cardiac inpatient wards and at an emergency care department at a Swedish hospital (Studies I & IV). Using employee questionnaires during the Lean implementation, teamwork and the psychosocial work environment were measured in two time periods (T1 & T2), a year and a half apart. To avoid post-hoc explanations, qualitative data about the intervention and the context was used to predict expected change patterns in teamwork and the psychosocial work environment from T1 to T2. These predictions were compared with the questionnaire data using linear regression analysis (Studies II & III).

Findings: A previous history of quality improvement was an antecedent for the hospital's adoption of Lean. Contextual factors seemed to influence both Lean implementation and its sustainability. For example, adoption of Lean varied with the degree to which staff saw a need for change. Continuous improvement, supported by visual management, when adopted successfully, kept the staff engaged and committed. Employee involvement in the Lean implementation may minimize the intervention's harmful effects on psychosocial work factors. Lean may influence teamwork, particularly in relation to structural and productivity issues.

Conclusions: The success of Lean implementation depends on its adaptation to contextual factors. In addition to the traditional focus of Lean on operational performance, the employee perspective is also important in designing, implementing and sustaining Lean. Engaging the employees in the Lean change process not only helps to sustain initial Lean success but also helps avoid harmful effects of Lean on the work environment. An initial Lean success may be sustained by engaging the staff in the change process using continuous improvement supported by visual management. Practitioners should note that, with groups struggling at initial stages of group functioning, the introduction of Lean may pose a significant challenge.

To my father, Maqsood Ulhassan (late)

LIST OF PUBLICATIONS

I. **Ulhassan W**, Sandahl C, Westerlund H, Henriksson P, Bennermo M, Schwarz U, Thor J. Antecedents and characteristics of Lean thinking implementation in a Swedish hospital: a case study. *Qual Manag Health Care*. 2013;22(1):48-61.

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CONTENTS

1 Introduction 1
1.1 Challenges for Health Care 1
1.2 Lean Management 1
1.2.1 History of Lean 1
1.2.2 Defining and Measuring Lean 2
1.2.3 Customer Focus in Lean 2
1.2.4 Employee Involvement in Lean 3
1.2.5 The Ultimate Goal of Lean 4
1.3 Lean in Health Care 5
1.3.1 Adaptation of Lean in Health Care 5
1.4 Teamwork 7
1.4.1 Teamwork in Lean Theory 7
1.4.2 Teamwork in Health Care 7
1.5 Lean and Psychosocial Work Environment 9
1.6 Summary 11
2 Aims and Specific Objectives 12
3 Methods 13
3.1 Study context 13
3.1.1 Danderyd Hospital 13
3.1.2 The Cardiology Department 13
3.1.3 The Emergency Department 14
3.2 Main Research Strategies 14
3.2.1 Case Study 14
3.2.2 The Pettigrew and Whipp Model of Strategic Change 15
3.3 Study design, Data Collection and Analysis 16
3.3.1 Study I and Study IV 16
3.3.2 Study II and Study III 20
3.4 Ethical Considerations 24
4 Findings 26
4.1 Study I 26
4.1.1 Lean Adoption at the Cardiology Department 26
4.1.2 Lean Efforts at Ward-I and Ward-II 26
4.1.3 Lean Efforts at the Cardiac ED 30
4.2 Study IV 33
4.2.1 Continuous Improvement at Ward-I 33
4.2.2 Continuous Improvement at Ward-II 34
4.3 Study II and III 34
4.3.1 Situation of Settings at T1 and T2 35
4.3.2 Documentation of Expected Outcome Patterns 35
4.3.3 Description of the Sample 39
4.3.4 Study II Findings 41
4.3.5 Study III Findings 43
4.4 Summary of Main Findings 46
5 Discussion 48

5.1 Context 48
5.1.1 Employees' Willingness to Change 48
5.1.2 Adaptation of Lean in Health Care 49
5.1.3 Sustaining Lean in Health Care 49
5.2 Content and Process 49
5.2.1 Work Redesign 49
5.2.2 Lean-inspired Teamwork 50
5.2.3 Continuous Improvement and 5S 50
5.2.4 Visual Management 50
5.3 Outcomes 51
5.3.1 Teamwork 51
5.3.2 Psychosocial Work Environment 53
5.4 Methodological Considerations 54
5.5 Future Research 56
6 Conclusions 57
6.1 Practice Implications 57
Sammanfattning på svenska 58
7 Acknowledgements 59
8 References 62
Appendix I: Interview Guide (Study I) 69
Appendix II: Interview Guide (Study IV) 70
Appendix III: COPSOQ Instrument (Study III) 71

LIST OF FIGURES

Figure 1. Pettigrew and Whipp's model with examples from the present project..... 15
Figure 2. A Model of Lean's effects on employees and patient care by Holden[1] 19
Figure 3. Timeline for Lean intervention and data collection at three settings..... 28
Figure 4. Actual changes in GDQ subscales at the three settings 42
Figure 5. COPSOQ patterns for scales most responsive to Lean at three settings 44
Figure 6. COPSOQ scale change patterns at three settings 46
Figure 7. COPSOQ scales change patterns at three settings 47

LIST OF TABLES

Table 1. A health care team typology adapted from Andreatta[95] 9
Table 2. Summary of the thesis studies' design, data collection and analysis..... 17
Table 3. GDQ Stages, scales, and subscales with sample items used in Study II 22
Table 4. Norms for GDQ scale scores..... 22
Table 5. COPSOQ domains, scales and sample items used in Study III 23
Table 6. An overview of Lean intervention parts implemented at the three settings 27
Table 7. Performance indicators with annual percentage change at the Cardiac ED 33
Table 8. Changes expected in GDQ subscales at three settings with motivations 36
Table 9. Changes expected in COPSOQ scales for Ward-I with motivations..... 37
Table 10. Changes expected in COPSOQ scales for Ward-II with motivations 38
Table 11. Changes expected in COPSOQ scales for ED with motivations 39
Table 12. Characteristics of the sample for each setting in Study II..... 40
Table 13. Characteristics of the sample for each setting in Study III..... 40
Table 14. GDQ actual scale scores at T1 & T2 for each setting 41
Table 15. Regression analysis results for GDQ and COPSOQ..... 41
Table 16. COPSOQ scale scores in the three study settings at T1 and T2 45

LIST OF TERMS AND ABBREVIATIONS

BSC	Balanced Scorecard is a multidimensional framework for describing, implementing and managing strategy at all levels of an enterprise.[2]
CI	Continuous Improvement is a culture of sustained improvement targeting the elimination of waste in all systems and processes of an organization by involving all the employees.[3]
COPOSQ	Copenhagen Psychosocial Questionnaire
CQI	Continuous Quality Improvement. Its purpose is to design quality in the process using statistical methods.[4]
ECG	Electrocardiogram is a machine used to measure heart's electrical impulses generated by the polarization and depolarization of cardiac tissues and to translate it into a wave form.
ED	Emergency Department
GDQ	Group Development Questionnaire
ICU	Intensive Care Unit
IMGD	Integrated Model of Group Development is a life cycle model of group development, developed by integrating aspects of other available models.[5]
IMVP	International Motor Vehicle Program
Lean	"Lean is an integrated sociotechnical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer and internal variability".[6]
MIT	Massachusetts Institute of Technology
Six Sigma	"A quality improvement methodology focusing on reducing errors and process variability".[4]
TPS	Toyota Production System is the production system developed at the Toyota Motor Corporation which is now commonly known as 'Lean'.
TQM	Total Quality Management is "The management philosophy to improve continuously the quality of products and processes to meet or exceed customer expectations".[4]
VM	Visual Management
VMPS	Virginia Mason Production System
VSM	Value Stream Mapping is "A primary Lean tools that describes the flow of material and information through a system. This is carried out by graphically portraying the current process, enabling one to see where value is added and lost".[7]

1 INTRODUCTION

1.1 CHALLENGES FOR HEALTH CARE

Given the increasing tension between resources and expenditures in health care, health care providers, especially hospitals, are under great pressure to increase their efficiency in providing patient care and in ensuring patient safety.[8,9] These challenges may be addressed in many ways, including reducing costs, shortening waiting times and minimizing medical errors.[7] Various solutions have been identified that may meet these challenges: for example, teamwork,[10,11] continuous improvement (CI)[12] and increased employee engagement[13] in the care process. Today health care providers use different business models, originating in the business sector, in their practice. Such models include Total Quality Management (TQM), Continuous Quality Improvement (CQI), Six Sigma and Lean Thinking (referred to as Lean in this thesis).[8,9,14,15] These management models, which emphasize process improvement strategies such as teamwork, continuous improvement and employee engagement[16,17] are appealing in the health care setting.

In addition, in recent years the Swedish health care sector has faced severe challenges such as reduced staffing, the increased care demands, and inadequate financing.[18] To meet these challenges, in the 1990s, many Swedish health care organizations tried to adopt and adapt different industrial management methods.[19-21] These actions meant there was a shift from traditional ways of controlling the public sector to a more participatory approach that included all stakeholders in the decision-making. As a result, physicians now have responsibility for medical care, and hospital managers have responsibility for administrative matters.[22] The adoption of Lean, among other improvement strategies adopted by Swedish health care organizations, may be seen as a part of the 'New Public Management' approach.[23] This shift has challenged the traditional medical hierarchy and has accentuated the power conflict between physicians and managers. Lean implementation in Swedish health care has had to deal with this challenge as well.

1.2 LEAN MANAGEMENT

1.2.1 History of Lean

Lean management was originally developed by the Toyota Motor Corporation (Toyota) in Japan under the name Toyota Production System (TPS).[17] Toyota, founded in 1933, began production of automobiles around 1950 in the financial crisis era of post-World War II Japan.[6] Because of the severe shortage of even the most basic necessities of life, many Japanese manufacturers began producing inexpensive consumer goods in an attempt to survive the recession. Toyota management, however, was convinced of the need to produce high quality automobiles despite the difficult economic circumstances. Therefore, Toyota management searched for new ways to do more with less.

The result was a novel production system known as TPS.[24] Henry Ford, in Highland Park, Michigan, had already developed the concept of 'flow' in the late 1910s.[25] Ford had developed assembly lines to transport and assemble automobile parts quickly and

efficiently. A Toyota manager, Taiichi Ohno, with others, advanced Ford's idea to suit Toyota's needs and resource constraints.[26,27] Several tools and techniques were developed that improved the production process using the available resources. The first person to use the term Lean for TPS was John Krafcik, a Master's degree student at the Massachusetts Institute of Technology (MIT) in the mid-1980s.[28] Further work on this method in the International Motor Vehicle Program (IMVP) at MIT produced the famous book, *The Machine that Changed the World* by James Womack, Daniel Jones and Daniel Roos.[29] This book introduced Lean concepts to the Western world.

1.2.2 Defining and Measuring Lean

Lean production, Lean manufacturing, Lean thinking and TPS are some of the terms used to describe the Lean method developed by Toyota.[6] However, the use of several terms to refer to one phenomenon creates ambiguity. Moreover, because the translation of Lean from TPS was complex, researchers have been left with a number of terms relating to different parts of TPS.[30] Because Lean has evolved over a long period and is similar to some other approaches,[29,31] this ambiguity over terminology is not surprising. The bigger issues, however, are the difficulties in describing Lean content and Lean measurement. Lean is usually described in one of two ways: as a philosophy of guiding principles and overarching goals[17] or as a set of management practices, tools and techniques.[32,33] This difference in descriptions of Lean may also relate to the complexity of translating Lean from TPS.[6] Japanese literature on Lean clearly describes the core philosophy of TPS and its underlying components. However, the earliest publications with the translation of Lean from TPS did not describe this philosophy and content as clearly.[34,35] Today, while the Lean literature comprises numerous books, research articles and editorials, we still lack a universally agreed-upon definition of Lean.

There have been some attempts to devise a method to measure Lean implementation.[6] In one study, the authors describe Lean implementation as bundles of practices, and propose a method to measure these bundles in a way that reflects the organization's approach to managing its production.[32] Another study includes only five items in a larger survey instrument used to measure Lean aspects in an organization.[33] Probably the most focused study on Lean measurement is by Shah and Ward [6] that provides a 48-item instrument for use in identifying ten underlying components of Lean. A Swedish health care study suggests, using a previously developed model, to measure different critical success factors for the five basic Lean principles.[36] Thus, the absence of both a common definition of Lean and a comprehensive and validated Lean measurement method adds to the challenge for researchers who study Lean empirically.

1.2.3 Customer Focus in Lean

Lean urges organizations to think about the whole system with a focus on the main purpose or goal of the organization.[37(p.15)] One cannot understand the system by merely identifying its unassembled parts. To understand the whole system, one must know its purpose, interdependencies and interactions. Understanding the organizational system is important because Lean is intended to be applied to the whole organization (e.g., product development, production, purchase and marketing).[24,38,39] Furthermore, the Lean implementation should be customer-focused.[17] Thus, the planning for changes in

the product and process, even at the organizational level, should be customer-focused. The emphasis on the customer in Lean means providing the best quality, in the shortest time, at the lowest cost. It also means engaging and motivating employees while also addressing safety and environmental issues for both employees and customers. The abbreviation for these issues is PQCDSM (Productivity, Quality, Cost, Delivery time, Safety and environment, Morale).[37(p.19)] The abbreviation reflects the Lean ideas of 'value' and 'waste'. Value is an attribute in the process that the customer is willing to pay for; waste is its opposite.[17,24] Therefore, a prime focus in Lean is to eliminate waste from the process and to improve the value of the product. However, simply following these steps using certain Lean tools and neglecting the overarching goal or purpose of the organization (system thinking) may lead to a failure in the long run.[37,40(p.18)]

1.2.4 Employee Involvement in Lean

A modern idea introduced by Lean, a departure from most previous business practices, was to involve employees in the decision-making process.[37(p.108)] Previously, the general management consensus was that employees with limited education and expertise were unable to contribute to the decision-making. It was preferable to keep them busy in their work in order to meet higher production targets.[41] Contrary to this thinking, Lean emphasizes that the numerous small problems related to shop-level jobs are best understood, analyzed and solved by the employees who do those jobs. This is true at all work levels in an organization. The essential idea was that employee involvement becomes more important in an era of modernization where there are diverse challenges of market, technology and finance.[37]

How can businesses involve employees in organizational decision-making processes? The idea of system thinking, described above, in a way, directs top management to consider the employees in decision-making. Lean guides management to involve the employees in the improvement work through the concept of CI. CI refers to the never-ending cycle of improvements that involves everyone in the organization through small group activities.[24(p.151)] Other management tools such as 5S and Visual Management (VM) also help involve employees in the improvement work.

1.2.4.1 5S

5S may be viewed as the foundation of improvement work.[24(p.73)] 5S is usually performed at the beginning of a Lean implementation and then is maintained forever. 5S stands for the five activities that should be undertaken in sequence. The Japanese names of these activities, their English equivalents and English translations (in parentheses) are as follows:

Seri – Sort (Organize)
Seiton – Straighten (Orderliness)
Seiso – Scrub (Cleanliness)
Seiketsu – Standardize (Standardize)
Shitsuki – Sustain (Discipline)

Thus, 5S aims to sort, order, clean, standardize, and maintain discipline in equipment and space in the workplace. The first, second and third activities refer to the

housekeeping of arranging, cleaning and organizing the workplace. The fourth activity creates standard procedures for work tasks. The fifth activity encourages discipline in support of the first four activities. The fifth activity not only helps provide the grounds for further improvement efforts but also creates an atmosphere of improvement work among the staff.[24]

1.2.4.2 Continuous Improvement

Continuous improvement (CI) has been defined as "a philosophy focused on problem solving to achieve gradual, orderly and continuous improvement throughout all the elements of the [production] process".[7(p.212)] CI aims to eliminate waste through small changes using *kaizen* events. *Kaizen* events should be planned, executed and evaluated in regular meetings using well-structured teamwork activities.[7] Farris *et al.*[42] found that team autonomy, management support and positive internal team dynamics are helpful in CI work. In health care, CI has been found helpful in improving the patient care process in several specialties.[12,43,44] The changes using CI were found more sustainable when the frontline staff was engaged in it.[12] According to Lean theory, employees may have greater autonomy and empowerment and enhance their work skills through CI.[17] However, Lean critics suggest that the increase in autonomy is insufficient for coping with the increased work intensity.[45] Moreover, they argue that because the objectives of work redesign are pre-specified in Lean in terms of eliminating waste and adding value to the process, this negates the claim of full autonomy.

1.2.4.3 Visual Management

Lean encourages distribution of information about planning, execution and follow-up of the improvement work across the organization by incorporating visual management tools and techniques for this purpose.[37] Visual Management (VM) consists of "a system that enables anyone to immediately assess the current status of an operation or process at a glance, regardless of the person's knowledge of that operation or process".[7(p.216)] The aim of VM is to create a work environment that is self-explaining, self-ordering and self-improving.[46] A VM tool is any tool that shares information non-verbally.[24(p.82)] VM has been suggested as a way to engage employees in CI in the industrial sector.[47] Parry and Turner[47] suggest that a visual management board (usually a whiteboard), developed and used independently by the employees in the workplace, may create ownership of the change process, and, in turn, help employees improve the process. These authors further suggest that, although underrated, VM is a powerful tool for use even outside the manufacturing industry.

1.2.5 The Ultimate Goal of Lean

What is the ultimate goal of Lean? Or, in other words, how can an organization become a Lean organization? Lean *culture*, which is the ultimate goal, is a culture in which everyone seeks improvement, understands value and strives to attain it, and identifies waste and struggles to eliminate it.[24,37] Thus, a Lean organization is one where change is the only constant, and employees understand that mistakes can be prevented. Yet it is also important to understand that becoming Lean is a long and difficult journey. The journey requires deep commitment and exhaustive work, over several years.[24] In fact, it is a never-ending journey as improvement is a continuous process. Because they have

neither understood this ultimate goal nor demonstrated a strong commitment to it, many organizations have failed to sustain Lean in the long run. Lean can only be sustained if everyone in the organization really believes in the new system and thinks that it treats everyone fairly.[17]

1.3 LEAN IN HEALTH CARE

Lean is an increasingly popular management strategy in health care, with reported improvements in the quality and safety of patient care.[1,40] In Sweden, a majority of the hospitals have implemented at least some parts of Lean in recent years.[48] Several reviews of the Lean literature in health care indicate widespread Lean implementation but also note that measuring the real impact of Lean on patient care is still a challenge.[1,9,14] These reports question the quality of studies that report Lean success. Most studies tend to describe superficial Lean implementation processes rather than explain how Lean actually has helped change the processes.[40] One insight is that no single Lean program is suitable for all situations. Rather, every organization must adapt Lean according to its needs and circumstances.[49,50] This has increased the emphasis on context when designing, implementing and evaluating Lean interventions.[40,51]

In simple words, context is potentially everything that cannot be characterized as part of the intervention or its outcomes.[52] Kitson *et al.*[53] describe context as 'the environment or setting in which the proposed change is to be implemented'. To study and evaluate a change intervention such as Lean, it is important to distinguish between the parts of intervention and its context.[52] The intervention and context interact as the intervention implementation proceeds.[54] Studying and analyzing this interaction help explaining how the context has influenced the change intervention. These understandings may help designing future change interventions.

1.3.1 Adaptation of Lean in Health Care

The translation of Lean principles to health care settings is an enormous challenge. As Lean was developed in an industrial setting, creating an effective Lean design for health care is not an easy task. This translation requires shifts in perspective: from customer to patient, product to services, a stable production process to a variable patient care process, factories to hospitals, and machines to human bodies. Moreover, this translation also requires a shift from training low skilled shop floor workers to training skilled professionals who are accustomed to making independent decisions. A common concern among staff, when Lean is implemented in health care, is their doubt about the suitability of Lean in health care.[7,55,56] This concern derives from the fact that factories and manufactured products are very different from hospitals and human beings.[50] Another concern may be the suspicion that Lean is just a new and temporary management fad with doubtful links to better outcomes.[57]

Yet the achievement and sustainability of the results of any innovation are tied to the willingness of employees to accept change.[58-60] The dissemination of information about Lean and basic training in Lean may help convince staff that the Lean philosophy may be used, even in health care, to reduce waste and to improve value in the care process.[61] However, Lean training of health care staff has its own challenges. Due to the lack of health care professionals with good knowledge of Lean, Lean trainers are often hired

from the manufacturing industry.[62,63] A problem may arise when health care staff does not readily understand Lean and its tools, especially when presented in manufacturing language and terms.[64,65]

The identification of value from a customer point of view is different in health care than in industry.[14] While patients are considered the primary customers in health care, health care staff, family members, decision makers, and even taxpayers are also concerned with the value of patient care.[14,66] Young has suggested, after reviewing the literature on value in health care, to focus on three aspects: *clinical value*, which is concerned with the best patient outcome, *operational value*, which is concerned with the efficiency of services, and *experiential value*, which is concerned with the experiences of patients and those working in health care.[14] This focus shows that health care staff should be considered in the translation of Lean principles.

The difference between the organizational structures in industry and in health care is also a challenge. Health care organizations are hierarchies in which physicians have ultimate decision authority on medical issues, and managers have similar authority on administrative issues. The Lean culture, which promotes participative decision-making, teamwork and collaboration, may differ from the traditional physician culture based in medical training and professional experience. [67] In short, there are challenges in the adaptation of Lean from industrial contexts to health care contexts that require further empirical investigation.

Although the Lean methods retain their conceptual strength, there is some ambiguity in understanding the mechanisms that make Lean successful.[40] It has been suggested that the chances of success in a Lean health care change intervention may be influenced by the fit between the actual approach taken and the circumstances of the adopting organization.[68] In the United States, the Virginia Mason Hospital in the state of Washington and the Pittsburgh Regional Health Care Initiative in the state of Pennsylvania are good examples of how Lean can be successfully transformed according to organizational needs.[69-73] Other organizations have also achieved good results through Lean transformations (e.g., Royal Bolton Hospital in the UK, Flinders Medical Centre in Australia, and ThedaCare in the state of Wisconsin).[8,55,74] Most of these organizations prepared their own version of Lean before implementation (e.g., the Virginia Mason Production System [VSMP]).[73] Some organizations, after finding other management strategies unsuitable, have then decided to adopt Lean.[70,74] Considering the context in designing an intervention is not a new idea.[75,76] The importance of context is emphasized in health care change models for quality improvement interventions.[68]

There is a gray area between what Lean is and what is not Lean in terms of definition, intervention, implementation and implications. This confusion is evidence that Lean is a new and growing field in health care. Hence, the terms – 'Lean efforts', 'Lean changes', 'Lean implementation', 'Lean thinking' and 'Lean intervention' – is called 'Lean' in this thesis and denotes 'Lean-inspired' efforts that refer to the change work performed with inspiration from Lean.

Womack and Jones state that the word 'team' is the 'hallmark' of Lean.[29] It is not surprising that teamwork is one of the three pillars of all the total quality-based management strategies including Lean.[77] CI can best be achieved through teamwork and collaboration among the staff.[16] CI activities often bridge hierarchical, functional and even organizational boundaries. Teamwork may help bridge hierarchical boundaries through collaboration between non-managerial staff and managerial staff, and between members of different professions. Teamwork may also help cross functional boundaries when multidisciplinary teams consisting of members from several units are made.[16]

1.4 TEAMWORK

1.4.1 Teamwork in Lean Theory

Two types of teams are described in the Lean literature: Lean teams and work teams. *Lean teams* are typically formed to perform Lean implementation activities and/or the resulting CI work. *Work teams* are the usual organizational teams that perform the regular work (e.g., patient care). Despite the fact that Lean and work teams have different scopes and different goals, the distinction between them is not very clear in studies on the relations between Lean and teamwork.[55,78-81] Some studies have shown the effect of Lean teams on the usual business process but not the effect of the Lean intervention as a whole on the performance of work teams.[78,80] Lean teams, which are usually temporary, are not involved in the usual business activities. This implies that these results may not represent the actual implications of Lean on teamwork in the core business, or health care, process.

However, some studies that have investigated the efficiency of work teams as a result of Lean interventions address the implications of Lean on usual business process teamwork. Three studies reveal that the better performance of work teams is an outcome of Lean, although without any quantitative measures of the outcome.[55,79,81] One longitudinal study with quantitative measures investigated the impact of Lean on teamwork, among other factors, and reported better results for physicians and nurses who work together, for support among the staff, for openness in speaking about problems, and for resolving conflicts.[82] Given the importance of teamwork in Lean and the scarcity of research in the field, further investigation is needed to understand how Lean and teamwork interact, and in which direction.

1.4.2 Teamwork in Health Care

Teamwork in health care has been described as "a dynamic process, involving two or more health professionals with complementary backgrounds and skills, sharing common health goals and exercising concerted physical and mental effort in assessing, planning, or evaluating patient care. This is accomplished through interdependent collaboration, open communication and shared decision-making. This in turn generates value-added patient, organizational and staff outcomes".[83]

There is substantial empirical evidence in the literature that team performance is crucial for providing safe patient care.[84] Poor coordination among care providers at various levels of the organization appears to affect the quality and safety of patient care.[85,86]

Effective communication and coordination are recognized as essential for improving quality and safety in emergency and acute medical settings.[85] Proficient health care teams contribute significantly to the financial, operational and developmental aspects of health care delivery.[87-89] Observational studies of teamwork have identified patterns of communication, coordination and leadership that support effective teamwork.[90] In Sweden, a national survey report and some empirical studies have shown that health care processes, patient outcomes and patient safety may benefit from multidisciplinary teamwork.[91-94]

1.4.2.1 Health Care Teamwork as Group Development

Health care teams are different from work teams in other businesses in many respects. Health care teams work in a frequently changing environment.[95] Their members often have different professional roles (e.g., physicians and nurses) and have different professional areas of expertise (e.g., medicine and surgery). Moreover, teams in other sectors mostly have stable roles with stable personnel whereas teams in health care have less stable roles with mostly varying staff.[95]

Andreatta[95] proposes that health care teams may be divided into four categories based on four combinations of stable or variable roles with stable or variable personnel (See Table 1). Most team models, imported from other sectors, were initially developed for teams with stable roles and stable personnel, which is not the case in health care. Most health care teams lie in the category of stable roles and variable personnel. This situation suggests that researchers should use caution when applying teamwork theories to health care groups.[95]

Group development theory[5] may be used to analyze health care teams with frequent variability in personnel. In an empirical study of teams in 17 Intensive Care Units (ICUs) at nine US hospitals, higher stages of group development correlated with lower mortality rates, and vice versa.[96] The Integrated Model of Group Development (IMGD), used in this study, defines a group as an organization that consists of group members who meet more or less regularly in the workplace.[5] This definition supports the argument for using group development theory in health care. This argument is strengthened as the ICU teams, studied with IMGD, have variable roles and variable personnel which is the farthest category from stable roles and stable personnel. Therefore, the use of this model for health care teams, even with their varying roles and/or personnel, seems justifiable.

Table 1. A health care team typology adapted from Andreatta[95]

		Team Role	
		Stable	**Variable**
Team Personnel	**Stable**	Stable Roles, Stable Personnel e.g., Ambulatory Care	Variable Roles, Stable Personnel e.g., Home health care
	Variable	Stable Roles, Variable Personnel e.g., Emergency Room	Variable Roles, Variable Personnel e.g., Hospital ICU

The IMGD suggests that groups ideally develop in five stages.[5] The first stage relates to inclusion and safety issues because members are new and are seeking secure positions in the group. The second stage includes opposing and counter-dependence issues when the members begin to argue about the group structure, process and roles. The model suggests that without this opposition over roles and responsibilities at an early stage, groups are unlikely to achieve better cooperation in later stages. These group conflicts also develop solidarity and promote openness. The third stage involves developing the work structure, identifying goals, defining roles and, at the same time, building trust among the team members. The fourth stage is the real work stage where productivity is at its peak, and the group has developed certain norms and values that smooth the work process. The fifth stage is the termination of the work for the groups that have a planned ending. According to this group development theory, groups cannot attain the needed level of structure, productivity and trust without dealing with the intra-group inclusion, relations and authority.[5,97,98] However, this five-step progression does not apply to all types of teams. For example, action teams, formed to solve a specific problem, typically concentrate more on the later stages of development.[99]

Teamwork can influence the psychosocial work environment. Kluger[100] found that job satisfaction is strongly related to teamwork among anesthetists. Piquette[101] found that team resources helped ICU staff deal with intense job demands. Another large quantitative study in primary health care suggests that teamwork with appropriate structure may help relieve different types of stress.[102] One industrial study, which investigated teamwork as a factor in workers' well-being under Lean implementation, found that managers perceived teamwork as positive whereas non-managers perceived teamwork as a time-consuming organizational fad with no positive influence on employee involvement.[103]

1.5 LEAN AND PSYCHOSOCIAL WORK ENVIRONMENT

Lean research in health care has mostly focused on process improvement aspects.[1] Few studies specifically focus on the implications of Lean for employees.[104] Lean has been criticized for increasing the work demands on employees and for negatively influencing work conditions in manufacturing.[51,104,105] However, both positive and negative

implications of Lean on work environments have been reported in several disciplines; the evidence is contradictory.[104,105] Hasle[104] suggests viewing Lean as a socio-technical system[9] in which its implications for the work environment should be interpreted in context. Several literature reviews note that Lean has many different implications for employees' work and work environments.[1,51,104,106] For example, as Lean transforms the work design, the employees responsible for making these changes are expected to be affected by them, either positively or negatively.[107] Moreover, the implications of Lean may be different for different psychosocial factors of work environment. Even in the Lean planning and preparation, when work design changes have not yet been implemented, employees may experience certain changes in their motivation, information access and social standing.[1] A Lean way of working also assumes a change in employee attitude: from merely doing their work to doing *and* improving their work.[17]

Researchers typically study the psychosocial work environment with reference to the demand-control model (DCM), the job-demands-resources model (JD-R) and the job characteristics model (JCM).[108] These models describe the psychosocial work environment in different ways. According to DCM, high job demands in combination with low job autonomy create a bad working environment for workers.[109] Moreover, this model assumes that a high degree of job autonomy and influence at work may prevent work stress, even if the job demands are high. The JD-R assumes that job demands and resources are two risk factors that relate differently to job motivation and job strain.[110] The JCM claims that the stronger experience of specific job characteristics should lead to more job satisfaction and better performance.[111] The DCM and JCM have been used in empirical Lean research to evaluate Lean's impact on the psychosocial work environment.[107,112,113]

Kristensen[114] suggests that no model or the questionnaires based on such models can encompass all the important psychosocial work factors. The Copenhagen Psychosocial Questionnaire (COPSOQ) was, therefore, intentionally developed from no single specific theory but rather from several theoretical models. Its aim is to include all the important psychosocial factors in one questionnaire. The COPSOQ has been tested for reliability and validity in several studies.[115,116] To the best of my knowledge, this questionnaire has not been used previously to investigate the implications of Lean on the psychosocial work environment.

These implications will likely differ depending upon how the Lean intervention is implemented. For example, if Lean leads to downsizing – which is contrary to Lean principles[105] – the implications should be different than if Lean is implemented with a holistic approach, as intended in Lean theory.[117] It is important to study employee perspectives because of the importance of employee involvement in Lean applications, as described above. Engaging employees in the change process helps sustain Lean results in health care.[62,118] Furthermore, CI activity helps maintain employee engagement in the Lean process.[12,13,40,42] The choice of methods and tools as well as employees' knowledge, creativity and commitment also help sustain Lean results. However, many organizations have failed to sustain Lean. Therefore, the realization of Lean's hoped-for benefits is a critical issue in health care.[50] It is unclear whether a Lean intervention developed consistent with employee needs and context and implemented

with good employee participation may significantly avert negative effects on the psychosocial work environment.[1,104,119]

1.6 SUMMARY

Lean, a business management strategy that originated in the industrial sector, has permeated the health care sector. The extant research contains conflicting evidence about the usefulness of Lean in health care. For example, sustaining the initial success of Lean efforts poses an enormous challenge in health care. Moreover, the socio-technical aspects of Lean, especially related to employees, are insufficiently understood. Teamwork is crucial to patient care, but few studies address the implications of Lean for teamwork. Because health care personnel work under stressful conditions, interventions such as Lean may influence their psychosocial work environment, both in intended, desirable ways and in unintended, undesirable ways. Indeed, the empirical evidence reveals both positive and negative implications of Lean for the work environment. It is difficult to establish causal relationships between Lean and these outcomes. If we are to understand and interpret Lean's implications, it is important to view Lean as a flexible phenomenon contingent on each context. A comprehensive approach to research, including longitudinal designs, is needed.

2 AIMS AND SPECIFIC OBJECTIVES

The main aim of this thesis was to explore and explain how Lean-inspired improvement efforts might work in health care and how they might relate to employees in terms of teamwork and psychosocial work factors.

The contribution of the four studies to the main aim was to:

a) Investigate the journey of a hospital department to adopt and adapt Lean internally and at another department and how these Lean-inspired efforts influenced employees' daily work. (Study I)
b) Explore and examine how the Lean-inspired efforts were related to changes in teamwork and the psychosocial work environment over time in a Swedish hospital. (Studies II & III)
c) Examine how Lean-inspired visual management practices, as part of continuous improvement (CI) efforts, were perceived by staff members – in particular how it related to their work and collaboration – at hospital wards in Sweden. (Study IV)

3 Methods

This chapter includes a description of the study context and the main research strategies used in this thesis. The specific study design, data collection and analysis for individual studies are also described.

3.1 STUDY CONTEXT

This research was carried out in a publicly funded Swedish hospital. The purpose of the Swedish health care system is to provide good health care for the entire population on equal terms, as stated in the Health care Act. Health care services are directed to pursue quality, safety, and cost-effectiveness. Democratically elected county councils and municipalities are responsible for providing health services, directly or via contractors, and generate the majority of health services financing through taxes.[120] In recent years, in attempts to improve quality of care including access to care, the Stockholm County Council, among others, has linked financial incentives to certain performance indicators.[121]

3.1.1 Danderyd Hospital

This research project analyzed the Lean-inspired improvement efforts in the Cardiology Department and the Emergency Department (ED) at Danderyd hospital. A 470-bed acute care hospital, it serves a population of about 440,000 in the northern Stockholm area, Sweden. Patients make approximately 243,000 physician visits each year.[122] The hospital has a long history of quality improvement efforts. Since the year 1990, it has applied different management strategies including Total Quality Management (TQM) and Balanced Scorecard (BSC) to meet two types of demands; firstly regarding the increasing volume of patient care, quality and safety; and, secondly regarding different contextual circumstances including purchaser demands from the Stockholm County Council.[20,123] In 2008, the hospital management was considering to start an organization-wide program to improve performance. Under these circumstances, with the appointment of a new hospital CEO, the hospital management developed a long term vision and plan with a goal to make the hospital a 'Queue-free' and 'Top-ranked' hospital within three years. This project was started in early 2009 and during that year, the management decided to adopt Lean Management as the main strategy to achieve its already set goals.

3.1.2 The Cardiology Department

Cardiology was a section of the Department of Internal Medicine until 2007 when it became a separate department. The services offered by the Department of Cardiology include cardiac intensive care, coronary angiography, pacemaker surgery, cardiac rehabilitation, and extensive outpatient care. The department has about 300 employees and a capacity of 74 beds in five wards. A cardiovascular research laboratory is also associated with the department. The two wards of focus in this study are described next.

Ward-I, which opened in 2007, is a small ward with a capacity of 18 beds. This ward deals with patients who have a maximum expected length of stay of 24 hours. Twelve beds are assigned for patients admitted from the ED with cardiac problems and six beds

are assigned for patients scheduled for pacemaker implantations or conversion of atrial fibrillation. This new ward, with relatively young and inexperienced staff, had high staff turnover during the year 2008 which reduced gradually during the year 2009.

Ward-II has a capacity of 26 beds and deals with patients who have chest pain, unstable coronary artery disease or myocardial infarction, congestive heart failure, rhythm disturbances or who need rehabilitation after cardiac surgery. The ward experienced an unusually high patient volume during the summer of 2010. There was rescheduling of working hours and decreased staffing on certain shifts at the ward as a result of a budget cut by the management during the second half of 2010. Although this change didn't lead to any downsizing of the staff, the turnover in 2010 was the highest ever during the ten-year history of the ward.

3.1.3 The Emergency Department

The ED at Danderyd Hospital is the main emergency facility in the northern Stockholm area. The ED has more than 80,000 emergency visits per year, almost half of which lead to hospitalization.[122] The number of patients has constantly increased during the last decade with a corresponding increased demand of services.[122] The patient volume varies substantially both daily and seasonally. The patient services at the ED are offered in different specialty sections: Cardiology, Internal medicine, Orthopedics and Surgery/Urology. Nurses are employed at the ED and continually rotate within all the four sections. The physicians, by contrast, work scheduled shifts at the ED but are employed at their respective specialty departments. Initially, the cardiac section of the ED (Cardiac ED) started Lean inspired changes in late 2008, having learned from successful Lean-inspired changes at another, nearby hospital. Inspired by the initial success of the Cardiac ED, the other three sections of the ED started to adopt the same Lean-inspired changes.

3.2 MAIN RESEARCH STRATEGIES

3.2.1 Case Study

Given the qualitative nature of the objectives of this thesis, a case study strategy was used. Case study designs are typically well suited for research questions focused on "why" and "how" rather than on "what", "how many" or "how often".[124] The case study approach can be termed a research strategy as it is not limited to any specific data collection or analysis method. Instead, it allows the examination of events of interest within their natural contexts.

This thesis is an observational study; the researchers did not intervene to affect the setting, but were given access to study the natural development of work-related changes over time. Thus, the Lean-inspired intervention was carried out by the hospital; the researchers only observed the process and obtained information. In this project, the case study approach allowed us to explore and describe the Lean-inspired improvement efforts and how they might be related to employee outcomes within their real world context. The case approach was adopted due to, firstly, the *"why"* and "*how"* type of research questions; secondly, the focus on contemporary events with some participants

providing retrospective information; and, thirdly, that the relevant events were not under the researchers' control.

Yin outlines three approaches in case studies: *descriptive*, *explorative* and *explanatory*.[124] The *descriptive* case study aims to simply describe a case in its real world context; the *exploratory* case study aims to explore and identify the research questions or procedures which may be used in some later study; the *explanatory* case study aims to explain why or how some events occurred or did not occur. The approach in this thesis was *explanatory* as I aimed to explain how Lean-inspired efforts in a health care setting might work and how these efforts might interact with teamwork and the psychosocial work environment.

3.2.2 The Pettigrew and Whipp Model of Strategic Change

As a framework for this explanatory case approach, I used Pettigrew and Whipp's Content-Context–Process-Outcome theoretical model of strategic change[125] (Figure 1).

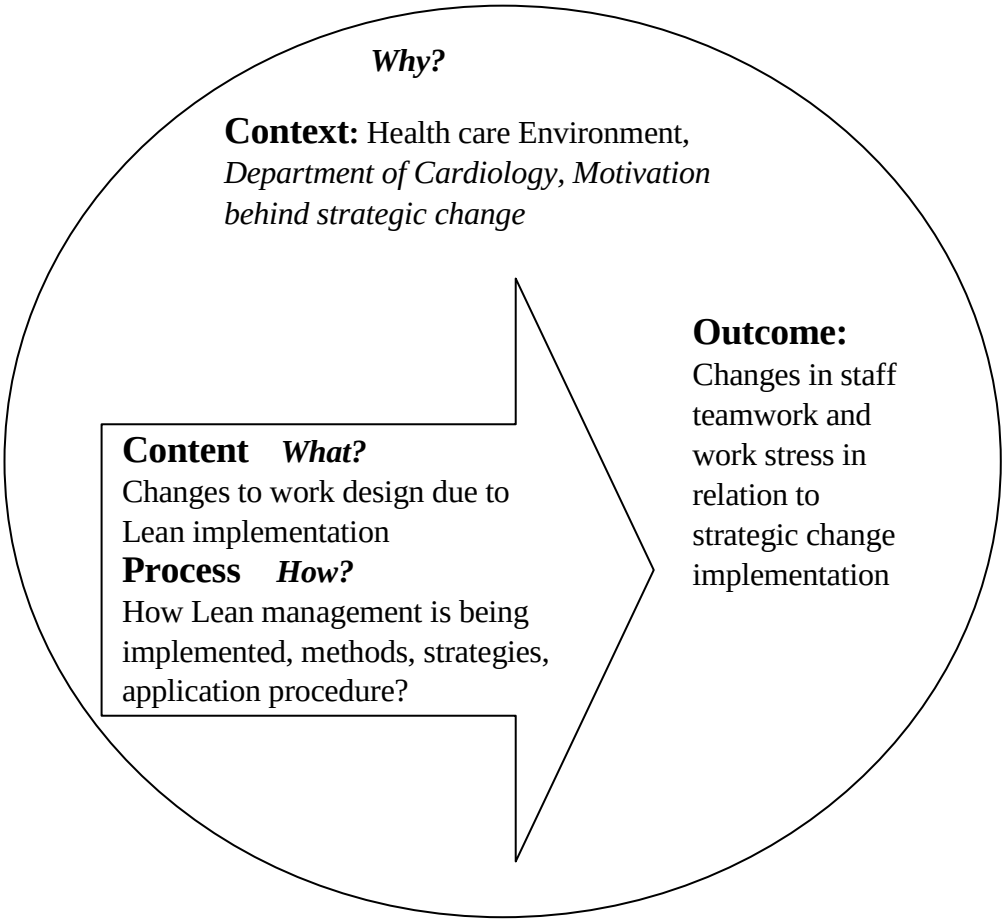

Figure 1. Pettigrew and Whipp's model with examples from the present project

Users of this model's three 'essential dimensions' of strategic change may interpret each term in slightly different ways. However, overall the model focuses on the *WHY* of strategic change with relevance to *context*; the *WHAT* of strategic change in terms of its *content*; and the *HOW* of strategic change in terms of *processes*. Pettigrew and Whipp argue that the interplay of these dimensions determines the success of strategic change. They also emphasize the importance of considering outcomes when analyzing strategic change initiatives. Literature reviews of Lean in health care call for a holistic

view including context and outcomes in terms of employees for studying and evaluating the Lean efforts.[1,40] Hence, I assumed this model appropriate to guide the research investigation as it was developed for strategic change and helpful for identifying potentially relevant influential factors.[126] Pettigrew and Whipp's model, as an overall framework, guided us to design the studies. Study I was designed to study the context, content and process of the Lean intervention. Study IV was focused to study a particular part of the intervention in detail, again in the light of context. Study II and III were focused to study two outcomes of Lean intervention related to employees i.e teamwork and work environment but we studied these outcomes again in the light of context, content and process of the intervention. In this way, Pettigrew and Whipp's model served an overall framework for this thesis.

3.3 STUDY DESIGN, DATA COLLECTION AND ANALYSIS

The following section describes the study design, data collection and analysis methods for each of the four studies (Outlined in Table 2). Studies I and IV, being case studies, are described together, and studies II and III, being mixed method studies, are then described together.

3.3.1 Study I and Study IV

Study I & IV are *explanatory single case* (embedded design) studies. Yin[124] has described five distinctive rationales for using a single case study design: 1) to test a theory with a critical case, 2) to describe an extreme or an unusual case, 3) to describe a common case, 4) to examine a phenomenon which was never inquired before (revelatory case), or 5) studying the same single case at more than one points in time (longitudinal case). An *embedded design* in a single case study involves units of analysis at more than one level of the same phenomenon whereas a holistic design involves a single unit of analysis in a single case. For example, in a single case study of a hospital, the analysis may include outcomes about the clinical services and staff employed by the hospital.[127(p.55)] In the holistic design, there is a risk that the focus of a case study may shift as the case study proceeds.[124] This may happen when the evidence starts to address different research questions and the implemented research design is no more appropriate for the research questions being asked. The benefit of using an embedded design is to avoid this unsuspected slippage from the original research question in holistic design as the case study proceeds.[124] It is better to choose more than one set of subunits if the researcher (or researchers) finds it appropriate before or during the case investigation. In Study I, the adoption of Lean and the adaptation of Lean were selected as two embedded units of the analysis. In Study IV, the CI work and use of whiteboards as Visual Management (VM) tools for CI work were the two embedded units of analysis. The explanatory approach, being appropriate to explain how or why certain event(s) occurred or did not occur, was used in accordance with the aim of these studies.[124] To enhance the quality of the research, multiple sources of evidence were used.[128]

Table 2. Summary of the thesis studies' design, data collection and analysis

Study	Study Design	Focus of Analysis	Quantitative data	Qualitative data	Time period for data collection	Data Analysis
I	Single case (embedded design) study	Rationale and evolution of Lean at three health care settings	Percentage of patients being discharged within 4 hours (Weekly averages)	9 interviews: 2 managers, 2 physicians, 3 nurses, 2 admin staff; and ~15 hours observations at each setting	Interviews: Jan – March, 2011 Observations: Apr, 2010 – Oct,2011	Manifest content analysis guided by Holden's Lean model
II	Mixed method (a survey within a case study)	Changes in group functioning over time under Lean	GDQ measured at two times one and a half year apart	Same as Study I	Surveys: May-Jun, 2010 & Nov-Dec, 2011 Qualitative data same as Study I	Linear regression analysis and Reanalysis of Study I qualitative data
III	Mixed method (a survey within a case study)	Changes in psychosocial work environment over time under Lean	COPSOQ measured at two times one and a half year apart	Same as Study I	Same as Study II	Linear regression analysis and reanalysis of Study I data
IV	Single case (embedded design) study	Use of VM in Lean-inspired CI work at two wards	Nil	7 interviews: 1st Round: 1 nurse manager, 2 physicians, 1 nurse, 2nd Round: 1 nurse manager, 1 physician, 1 nurse, ~10 hours observations at each setting, 20 photographs	Interviews: Apr – May, 2011 & Apr – May, 2012 Observations and photographs: Apr, 2010 – Jun, 2012	Manifest content analysis

3.3.1.1 Qualitative data collection

In both Study I and Study IV, qualitative data were collected through interviews, observations and documents. The semi-structured interviews had open-ended questions[129] and were conducted with key informants selected by purposive and snowball sampling. Thus as a start, the persons involved in, and responsible for, the Lean work were invited, as they were assumed to have the best information about the case under study. The initial interviewees, in turn, suggested other persons who had additional information about the different aspects of the case. In Study I, the interviews focused on the history of quality improvement work, planning and execution of the Lean intervention, factors facilitating and hindering the change process, employees' role in the Lean implementation and the implications of the intervention to the employees' daily work. In Study IV, the interviews focused on the continuous improvement process, the use of visual management in this process and the factors facilitating or hindering in the adoption of CI and VM in the wards. An interview guide was developed and used for each study (See Appendix I and II) allowing adaptations in response to the answers by the interviewees as the interview proceeded. Interviews ranged from 1 – 1.5 hours of duration, were electronically audio recorded, and were conducted on the hospital premises. All the interviewees gave their informed consent in writing.

Non-participant observation is a data collection approach aimed to "follow the flow of natural events in a way that behavior and interaction continue as they would without the presence of a researcher".[130] This type of observations is usually employed when the researcher(or researchers) is not playing any role in the intervention implementation.[131] In Study I, the observations were focused on work flow, information flow and employee roles. In Study IV, they focused on CI work and the use of VM tools in the wards. Observations also included attendance at some Lean meetings in different settings to gain a deeper and broader knowledge of the change process. The observation data were documented in the form of written case notes.[132] These case notes also included occasional discussions with the staff.

Certain documents, although not produced for the purpose of research, may contain useful information that can be used for research.[131] In Study I, to complement interviews and observations, we also collected annual reports of the weekly percentage of patients discharged within the 4 hour length of stay target at the Cardiac ED. In addition to this, we collected some documents regarding the organizational structure of the Cardiology Department.

Photography has long been used as a data source in anthropology and ethnography.[133] Photographs, as a complementary source of data in case studies, allow a researcher to record observational data in real-time and then analyze them later.[131] In study IV, more than 20 photographs of the whiteboards at Wards I & II were taken on different occasions to record the use of VM in the CI process.

3.3.1.2 Qualitative data analysis

In both studies, the data gathered through different means were subjected to manifest content analysis[134], i.e. the data were analyzed to obtain the manifest information about

the case rather than interpreting them for the underlying meanings of the interviewees' responses. In Study I, the interviews were transcribed verbatim, coded and organized into categories. The observation notes were read repeatedly to organize the data into the same and/or new categories. All of the rich data extracted from interviews, observations and documents were merged to create the case description. Study I data analysis was guided by Holden's Lean model.[1]

A Lean Model by Holden

Regarding the Lean intervention, this comprehensive model based on some empirical evidence, entails the role of context and changes made to work design within the work structure and the work process (Figure 2). *Work structure* refers to work system elements (e.g. tools, technology), worker factors (e.g. education, training), organizational factors (e.g. policy, staffing and incentives), communication factors and the physical environment. *Work process* refers to the actual work tasks carried out in patient care processes and related activities. The model emphasizes the importance of context in any Lean implementation. The model states that the success (or otherwise) of Lean interventions depends upon how well the intervention fits into the local context. Guided by this model, the enriched data were divided into four categories with information about: i) context, ii) the Lean intervention, iii) Lean changes made in the work design and iv) the Lean intervention's impact.

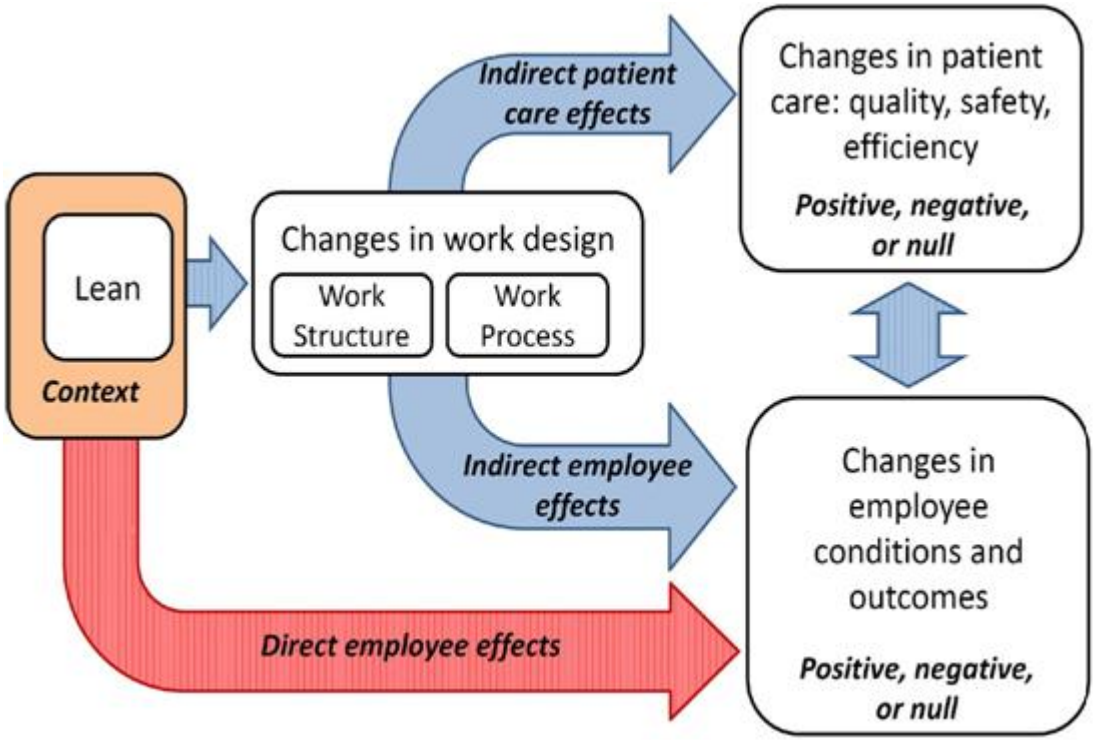

Figure 2. A Model of Lean's effects on employees and patient care by Holden[1]

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This model partly resembles the general model of strategic change by Pettigrew and Whipp[135], although Holden's model focuses specifically on Lean intervention changes. Both models give importance to the study context and content of the change. Regarding the change process, Holden's model specifies it only to the changes in the work design whereas the Pettigrew and Whipp model includes strategies, methods and even application procedures in it. Regarding the outcomes, Pettigrew and Whipp are again open to any types of outcomes whereas Holden's model categorizes outcomes into changes in patient care and employee conditions. In short, Holden's model may be considered as an application of Pettigrew and Whipp model to the study of Lean intervention changes and their implications both for patient care process and employees. Hence, I used Holden's model to guide my analysis of the Lean application here.

In Study IV, the recorded interviews were listened to repeatedly and the observation notes were read also repeatedly to obtain manifest information about the case. The photographic data were used to complement the information obtained from other sources about the CI work. All the data were combined into the case description.

3.3.2 Study II and Study III

To investigate the implications of Lean-inspired changes for group functioning and psychosocial work environment, Studies II and III used a mixed method design combining qualitative and quantitative data approaches. In both studies, quantitative data were captured via surveys; the Group Development Questionnaire (GDQ) in Study II and the Copenhagen Psychosocial Questionnaire (COPSOQ) in Study III. (See Appendix III for COPSOQ instrument used. GDQ instrument cannot be shared due to copyright restrictions.)

3.3.2.1 Quantitative Data Collection

Questionnaire data were collected at two time points, first in May-June 2010 (T1) and then again in November-December 2011 (T2), during the Lean implementation process. All the measured dimensions were assessed twice as the same questionnaire and demographic survey was used at both times. The employees were assigned unique identifying (ID) numbers which helped to trace the responses from the same individuals at the two times, making repeated measures analysis possible. One person was assigned as a data collection facilitator in each setting by the respective hospital department. The employees at each setting had an opportunity to attend one of the 2-3 information sessions where the data collection facilitator described the study and how to fill out the questionnaire. The questionnaires were manually delivered to the employees post boxes at their workplace. At T1, the participants returned the questionnaires in a sealed cardboard box placed in each setting at an appropriate place. Although this procedure was completely secure to ensure the confidentiality of participants' responses, some participants expressed uneasiness with dropping the responses in the cardboard box while others could see them. Hence, at T2, the participants returned the questionnaires through regular mail using the return envelopes enclosed with the questionnaires. Email reminders were sent to the non-respondents, tracked by ID-numbers, after two, four and six week time to increase the response rates.

3.3.2.2 Qualitative Data and Analysis

The qualitative data collected in Study I was reanalyzed to help predict changes in the survey scale scores from T1 to T2. The idea was to document whether each scale in GDQ and COPSOQ would improve, deteriorate or change negligibly in light of the qualitative information – including both the actual Lean implementation that had taken place and contextual changes. The reanalysis was performed through discussions among the authors of the study. For each scale, the authors independently identified, and then discussed to reach a consensus about, how the observed Lean changes and/or other parallel changes might cause a change in each scale score. They documented the expected change for the GDQ subscales (Study II) and for the COPSOQ scales (Study III), also taking the starting point (the T1 results from the survey) into account. Here, however, the purpose was not to see if the intervention succeeded or not. As we were studying a real-world "Lean-inspired" change program and not a "theoretically pure" Lean, we urged to factor in the varying degree of Lean fidelity in the actual application in the three settings. Hence, the authors sought a form of triangulation by combining qualitative and quantitative data to avoid relying on post-hoc explanations and increase the reliability for the findings.

The authors did this in a stepwise manner by first analyzing the qualitative data and then looking at the quantitative data. Hence, they called it expectations but in a very narrow, technical sense and it should not be understood as a standard hypothesis. A standard hypothesis is supposed to be developed based on the available research and not on the study data. Before the quantitative analysis, in the light of a synthesis of Lean literature on the psychosocial work environment [17,103,104,107,112,136], the authors also predicted that some of the scales were most likely to be affected by Lean implementation (below called 'most responsive to Lean'). These scales are highlighted in Table 5. Considering the four domains, we predicted that the two domains 'Work Organization and job content' and 'Interpersonal relations and leadership' are more responsive to Lean than the other domains.

The expected changes were documented as positive (an improvement coded as +1), negative (deterioration coded as -1) or null (coded as 0). 'Null' was used to denote no change, defined as a change between +1.5 and –1.5 in scale score value. The actual survey outcomes were then compared with the expected outcomes through linear regression analysis. As the focus was to compare the actual overall change patterns with the expected ones, the independent variable was the expected direction of change (+1, -1, 0) and the dependent variable was the actual net score. Hence, the regression analysis outcome showed if the actual change patterns corresponded to the expected ones. This regression analysis was performed using Statistical Package for the Social Sciences (SPSS, version 19). According to the questionnaire author instructions and using the responses, the separate scale means were computed for T1 and T2. After Z-score transformations, net scores were obtained by subtracting means of T2 from T1.

3.3.2.3 Group Development Questionnaire (GDQ)

In Study II, a Swedish language version of the Group Development Questionnaire (GDQ-SE3) was used.[137] This questionnaire is based on the IMGD which suggests that groups develop through stages.[5] The questionnaire has been validated through a

number of validity and reliability tests indicating that GDQ has appropriate psychometric properties.[138] GDQ has a total of 60 items consisting of 4 scales corresponding to 4 stages of group development. Table 3 gives an overview of the GDQ with its four stage scales, subscales and sample items.

Table 3. GDQ Stages, scales, and subscales with sample items used in Study II

Group development stage	Scale	Subscale	Sample items
Inclusion and Dependency	I	Inclusion & Safety Concerns	There is very little conflict expressed in the group.
		Dependency Issues	Members tend to go along with whatever the leader suggests.
		Lack of Structure	We haven't discussed our goals very much.
Fight and Counter dependency	II	Fight	People seem to have very different views about how things should be done in this group.
		Negative Emotions	There is quite a bit of tension in the group at this time.
		Counter-dependence	Members challenge the leader's ideas.
		Signs of Emergent Structure	More people are participating in group discussions but we are not a cooperative group yet.
Trust and Structure	III	Structure	The group is spending its time planning how it will get its work done.
		Trust/Cooperation/ Positive Emotions	We can rely on each other. We work as a team.
		Leader as a resource	The leader of this group is viewed as an asset to group goal achievement.
Work and Productivity	IV	Effective Organization	The group gets, gives and uses feedback about its effectiveness and productivity.
		Culture/Norms/ Values	This group encourages high performance and quality work.
		External Relations	This group has good relationships with other groups with whom it interacts.

Table 4. Norms for GDQ scale scores

Scale I	Scale II	Scale III	Scale IV	Stage
>42	<42	<50	<53	I
<45	>46	<50	<53	II
<44	<40	51-55	54-59	III
<44	<40	>56	>60	IV

Note. GDQ Scale Norms are based on data from Swedish study populations.[137]

Table 5. COPSOQ domains, scales and sample items used in Study III

Domain	Scale Name	Sample Items
Demands at work	*Quantitative demands*	Do you get behind with your work?
	Tempo at work	Do you have to work very fast?
	Cognitive demands	Do you have to keep your eyes on lots of things while you work?
	Emotional demands	Does your work put you in emotionally disturbing situations?
	Demands for hiding emotions*	Does your work require that you hide your feelings?
Work organization and job content	*Influence at work*	Can you influence the amount of work assigned to you?
	Possibilities for development	Does your work require you to take the initiative?
	Meaning of work	Do you feel that the work you do is important?
	Commitment to the workplace	Do you feel that your place of work is of great importance to you?
	Rewards at work	Is your work recognised and appreciated by the management?
Interpersonal and leadership relations	*Predictability**	Do you receive all the information you need in order to do your work well?
	Role clarity	Does your work have clear objectives?
	Role conflicts*	Are contradictory demands placed on you at work?
	Social support from colleagues	How often do you get help and support from your colleagues?
	Social support from supervisors	How often is your nearest superior willing to listen to your problems at work?
	Social community at work*	Is there a good atmosphere between you and your colleagues?
Values at the workplace	Horizontal trust*	Do the employees in general trust each other?
	Vertical trust	Does the management trust the employees to do their work well?
	Justice and respect	Are conflicts resolved in a fair way?

Note: Scales denoted by an asterisk were used in full while others were used partially. Scales in italic style were deemed to be most responsive to Lean intervention.

The items on each scale help to detect the presence or absence of characteristic behaviors of groups at the corresponding stage of development. The scales are further categorized into 3-4 subscales each with a total of 13 subscales. It takes about 15 to 20 minutes to complete the questionnaire responses. Scale I items detect Stage I of group development which represents inclusion and dependency issues. Similarly, Scale II, III and IV detect the issues regarding conflict and counter dependency (Stage II), structure and trust (Stage III) and work and productivity respectively (Stage IV). Each scale has 15 items scored from 1 (never true for this group) to 5 (always true for this group) giving a minimum and maximum score of 15 and 75 on each scale. A decrease in Scale I and II and an increase in Scale III and IV scores indicate a group's development towards higher stages and vice versa. The comparison of the scale scores helps to detect the present stage of development of a group under study. Table 4 gives scale norms with cutoffs for establishing the development stage of a group under study based on Swedish population scale norms.

3.3.2.1 Copenhagen Psychosocial Questionnaire (COPSOQ)

In Study III, the long version (appropriate for research purposes) of the Copenhagen Psychosocial Questionnaire in Swedish language (COPSOQ-II)[115] was used as a starting point. The COPSOQ is a comprehensive questionnaire widely used to assess the psychosocial work environment in organizations.[114] According to the purpose of the study, the questionnaire was shortened by including only the scales deemed relevant to the intervention. Some scales were shortened by removing items with the lowest factor loadings to avoid producing an unnecessarily lengthy survey. Out of 41 scales, 19 scales were used consisting of 5 full scales and 14 partial scales coming from 4 major domains. It takes about 20 to 25 minute to complete the questionnaire responses. Table 5 describes the major domains used with scales and sample items.

Out of the total 45 items, 13 items were scored from 1 (Always) to 5 (Never), 5 items were scored from 1 (Always) to 6 (Not related) and 27 items were scored from 1 (To a very high degree) to 5 (Almost not at all). According to the instructions provided by the authors of the instrument, the average scale scores were rescaled from 0 to 100, where 0 represented the lowest degree of each measured psychosocial factor and 100 represented the highest degree. Depending upon the scale nature, a higher score may represent either a better (e.g. Role clarity) or worse (e.g. Role conflicts) psychosocial work condition.

3.4 ETHICAL CONSIDERATIONS

In accordance with the Swedish Law (SFS 2003:460), the plans for all the four studies were submitted to, and approved by the Regional Ethical Review Board in Stockholm (file number: 2010/235-31/4).

For survey data, the coding of the participants was not shared with any other person to ensure participants' confidentiality. The coding was only used to identify the participants who responded at both time points (T1 & T2) and to track the non-respondents for reminders in order to increase the response rate. Prior to the questionnaire distribution, the participants received written and oral information about the study. They also received a cover letter describing that their participation in the

study was voluntary and that informed consent would be implied by completing and returning the questionnaire.

For interview data, all the interviewees were informed before the interview that the interviews were voluntary, could be stopped or abandoned at any time without providing any reason. They were asked if the interview could be tape-recorded. All the interviewees gave their consent in writing. The interview data, including direct quotes, are presented in the studies without revealing interviewees' identity.

For observation data, the staff was informed about the presence of the researcher. The observations were conducted in a way to keep the researcher's participation in the situation to a minimum in order to avoid influencing the staff. The staff members were consulted in this regard to attain a satisfactory level of "non-participation". In the case of any discussions made between the observer and staff member(s) or between the staff members being observed, the discussants were informed that these discussions would be documented and used for the research purposes.

The four studies were not expected to pose any major risk of harm or discomfort to the participants. The only risk for those who chose to participate in data collection could be due to a part of working time to be utilized for this participation. Furthermore, the questionnaires possibly sensitize the thoughts or feelings that could be perceived as troublesome. However, these risks were rated as minor risks in our ethical application and the ethical board approved to undertake the studies.

4 FINDINGS

This section describes the findings from the empirical studies of this project. The findings are described firstly about different aspects of Lean application (Study I & IV) and then how it relates to employees in terms of teamwork and work environment. (Study II & III)

4.1 STUDY I

The aim of this study was to investigate how a cardiology department with a long quality improvement history reached a decision to adopt Lean and how it then adapted and applied it. The study investigated this at three sites, Ward-I, Ward-II and the Cardiac ED.

4.1.1 Lean Adoption at the Cardiology Department

The Cardiology Department at the hospital has its own history of improvement efforts in terms of streamlining and organizing the work into three distinct care processes i.e. care for i) ischemic heart disease, ii) heart failure, and iii) arrhythmias. While most physicians typically circulate among departmental units, in contrast to other professionals who typically are more stationary, managers had made efforts all along to include physicians in change efforts. Despite these efforts, the managers were still realizing a need to enhance patient care processes to manage the increasing patient volumes. During 2007, the department management sought to involve also nurses in the change process, in addition to the physicians and managers that historically had been most involved. In early 2008 (before the general Lean management strategy was launched at the hospital level), the department's management, inspired by another hospital in Stockholm, decided to adopt Lean management. The aim was to 1) make the care processes more efficient so as to meet the demands of patient volume growth and 2) involve the employees more in the change process. Initially, two of the Department's four wards (its fifth ward was opened during 2009) implemented Lean. Encouraged by the initial experience and departmental leaderships' support, the other two wards (Ward-I and Ward-II in this study) introduced Lean during the first half of 2010. Figure 3 shows time periods for Lean implementation in these settings and the collection of different data sources for this thesis.

4.1.2 Lean Efforts at Ward-I and Ward-II

4.1.2.1 The Lean Intervention

The planned interventions at Ward-I and Ward-II were almost the same. The intervention included Lean training and some tools and techniques as shown in Table 6. The staff at both wards received 2 days of Lean training by an external consultant including exercises of LEGO® brand block simulations of production processes. The staff at Ward-II perceived that way of training as not very suitable for them as health care personnel. It created a feeling among the staff that an industrial management strategy was being forced onto health care services. The wards applied 5S (see above) and Value Stream Mapping (VSM). Guided by the VSM, the ward made changes to the work design. VSM helped the staff to find weaknesses in the processes and opportunities to improve them.

Table 6. An overview of Lean intervention parts implemented at the three settings

Lean Intervention	Ward-I	Ward-II	Cardiac ED
Education/Training	2 days training for the whole staff by external consultant	2 days training for the whole staff by external consultant	Only Lean coaches were trained by the hospital's Quality Development Group
5S	Executed with keen employee involvement	Executed with the support of Lean coaches	Executed with the support of Lean coaches
VSM	Executed by Lean coaches including employee discussions	Executed by Lean coaches	Executed by the flow group
CI & VM	Executed through employee discussions and sustained	Started by Lean coaches but couldn't be sustained	Planned by the flow group but couldn't be implemented
Work Redesign	A joint workstation for physicians and nurses, nurse aides equipped with trolleys having laptops, colored magnets for patient status, patients seen one by one.	One workstation for physicians and nurses, nurse aides equipped with trolleys having laptops, colored magnets for patient status, patients seen one by one.	One workstation for physicians and nurses, one part-time junior physician now full-time, ECG machine stationed in preliminary care room, heart coordinator to admit patients from ED to wards
Teamwork	2 care teams; in each team, physicians and nurses started working in pairs	3 care teams; in each team, physicians and nurses started working in pairs	Team for preliminary care consisting of a nurse and a junior physician led by a specialist

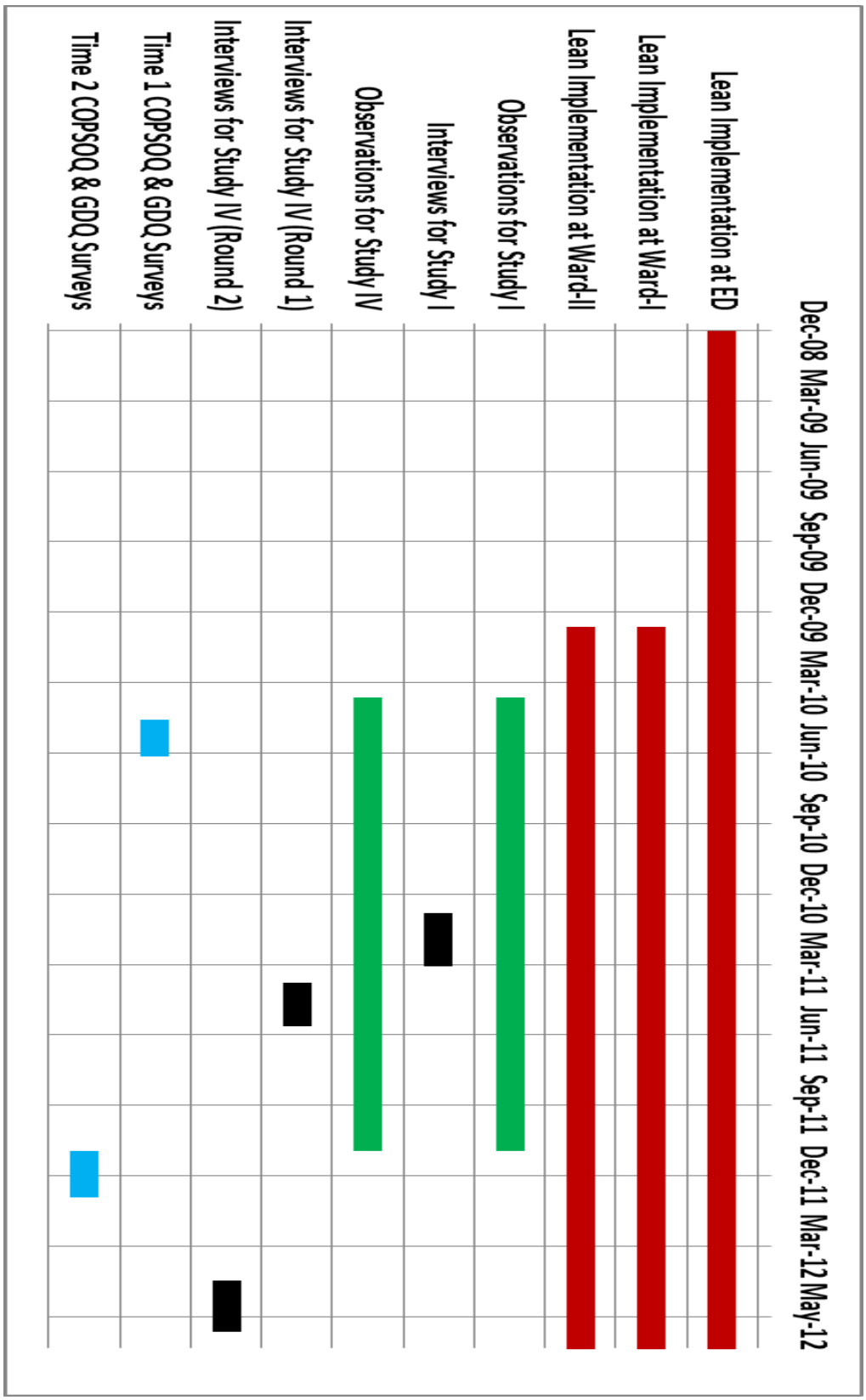

Figure 3. Timeline for Lean intervention and data collection at three settings

Note. Red bars denote Lean intervention, black bars denote interviews, green bars denote observations and blue bars denote surveys.

We divided those changes into structure changes and process changes, according to the Holden model.

4.1.2.3 Changes in Work Structure

As a result of VSM, the separated workstations for physicians and nurses in the wards were identified as a waste in the process, as this led to nurses having to call, and wait for, physicians. The physicians and nurses were therefore seated together in a new workstation. Another form of waste identified in the process was the way nurse aides used to go and fetch pharmaceuticals from the storage, every time they were needed. The nurse aides were, therefore, provided with trolleys and laptops for medication distribution to have common pharmaceuticals at hand on the trolley and be able to check the pharmaceuticals needed for each patient using the laptop. The patient status boards were equipped with colored magnets for visual information sharing; red magnet indicating a new patient with a need of medical assessment; blue magnet a patient who could be seen later; green magnet a patient waiting for further test and evaluation; and yellow magnet a patient ready to be discharged.

4.1.2.4 Changes in Work Process

Short daily morning and afternoon meetings were started. The purpose was to plan the day's work in the morning meeting and review the day's work in the afternoon meeting to identify any improvement opportunities. At Ward-II, the morning meetings were initially mixed with whiteboard CI meetings. Later, it was decided to hold separate morning meetings for each of Ward-II's three care teams instead, and these meetings were then sustained. Teamwork was adopted at both wards. At Ward-I, 2 teams were formed per shift, each team consisting of 1 junior physician, 1 nurse and 1 nurse-aid. The senior cardiologist worked with both teams during the shift. At Ward-II, 3 teams were formed per shift, each team consisting of 1 senior and 1 junior physician, 2 nurses, and 1 to 2 nurse aides. The nurses perceived this as a good change since the physicians were more readily available to them. The physicians, spending more time at the ward, became more familiar with the patients and the process information. Another important process change was to visit and assess the patients one by one and making individual plans directly. Previously, the maximum possible patients were assessed until noon and then decisions were made e.g. whether the patient could be discharged. The goal now was to discharge as many dischargeable patients as possible before noon. This change was also influenced by a policy statement by the hospital management that at least 50 % of the patients who could be discharged on a given day should be discharged before noon. The purpose of this policy was to minimize the previous workload peak in the afternoon which was a result of two things happening at the same time; discharges from the wards and influx of patients from the ED.

4.1.2.5 Lean Interventions' Analysis

Although the Lean interventions on the two wards were almost identical, their fate was not the same. The intervention went very well in Ward-I. The mostly young staff was enthusiastic and engaged under the supportive leadership of ward managers. The Lean intervention at Ward-II, in contrast, was not as successful. The staff only accepted the change half-heartedly as they did not perceive an urgent need for improvement – they

felt that they were doing well as it was. The Lean intervention was only partly adopted as intended. Attempts to start CI with VM could not be sustained. One problem was the morning meetings. The CI activity was mixed in with the morning meeting despite that CI and morning meetings had different goals. The morning meetings were intended for planning of the day's work while the CI was aimed at problem solving and improving the care process through small changes suggested by the staff. It did not help that this meeting initially was held for the whole ward staff which was not suitable as different sections of the ward served different kinds of patients with different patient care processes. In addition, several contextual factors may have further hampered the Lean intervention on Ward-II. The staff faced a high increase in patient volume in mid-2010, immediately after the introduction of Lean. Furthermore, a budget cut later in 2010, brought re-scheduling of working hours and decreased staffing on certain shifts. Although nobody was laid off, this caused an increase in working hours for the staff. Thesse issues likely distracted staff from the change efforts. The turnover was very high at this ward during the second half of 2010. According to some interviewees' perceptions, this was due to, among other things, dissatisfaction with the changes in work design, leadership and re-scheduling of the working hours. The head nurse left during 2011 and a new head nurse took charge after a few months and started efforts to revive Lean in the ward.

4.1.3 Lean Efforts at the Cardiac ED

The decision to implement Lean changes at the Cardiac ED was inspired not only by the Cardiology Department's initiative but also by a new target for emergency departments set by the county council: at least 80 % of patients should be done and leave the ED within four hours. During the intervention implementation period, the ED underwent several managerial changes including the head of the ED.

4.1.3.1 The Lean Intervention

A special team termed the 'flow group' was formed and made responsible for the Lean work. The group had eight representatives from the Cardiac ED, led by the physicians' unit head at the Cardiology Department and assisted by an improvement advisor from the hospital's quality development group. The 'flow group' met once a week. The eight members of the flow group attended the Lean training workshops administered by the hospital's quality development group. They used Value Stream Mapping to produce a current state map. On the basis of patient demand, review of performance data, and identification of possible sources of waste in the process, a future state map was then developed. The length of stay was found to depend predominantly on four factors: i) the number of patients, ii) clinicians' competence and experience, iii) staffing, and iv) work design. The only variable considered amenable to change was the work design. The existing work design was not sufficient to cope with the increasing number of patients and only produced congestion, increased workloads and reduced vision. The major change proposed to the work design was that the patients should be seen by an experienced physician earlier in the process. After some meetings, trials on small scales and suggestions, a change prototype was approved by the flow group to be implemented. An implementation plan was prepared with the help of local managers. The flow group met at least twice a month after the implementation. The group

continued to review the performance and proposed new changes which were tested, evaluated and implemented accordingly.

The different parts of the planned Lean intervention at the Cardiac ED are given in Table 6. The changes made at the Cardiac ED as a result of the Lean intervention are described here.

4.1.3.2 Changes in Work Structure

Physical work setting redesign: The physicians and nurses, who used to sit separately, were gathered at one workstation. This made the physicians more available to the nurses. Some of the physicians expressed concern with this change as, in their opinions, this affected their privacy; for example, by not being able to have a free telephone conversation at times. The increased presence in the working area, however, also meant that the physicians had easier access to their partner nurses as well as to patient information.

Enhanced staff utilization: The staff capacity was enhanced with replacing a part-time junior physician position with a full-time position. After this change, the staff capacity increased in terms of more physicians available to see patients. A "Heart coordinator" position was created at the Cardiology Department which was an indirect increase in the staff capacity at Cardiac ED. The Heart coordinator, working regular office hours, discussed admission needs with physicians and remained up-to-date on bed availability. The Heart coordinator was available by phone and also came to the Cardiac ED to move patients to be admitted to the cardiac wards. Before this change, ED physicians had to call the wards to check bed availability which was time consuming. Thus, this change also increased ED physicians' availability for seeing patients.

ECG machine: According to the new structure, it was prohibited to move the ECG (Electrocardiogram) machine out of the preliminary assessment room. Previously, there was no fixed place for it and the nurses often had to search for it, thus wasting time.

4.1.3.3 Changes in Work Process

Preliminary assessment: The major change in the work process was to introduce teamwork for the preliminary assessment. Previously, the patient was examined sequentially by a nurse, a junior physician, and sometimes by a senior cardiologist one by one which was time consuming. After the change, the patient was directly examined by all of these three jointly in the form of a care team. Led by the senior cardiologist, the care team examined the patient in not more than ten minutes. Occasionally, when the junior physician was unavailable, the other two members performed the preliminary assessment. Usually, the nurse checked the vital signs before the assessment and the junior physician recorded the patient's history electronically during the assessment. This teamwork approach helped to obtain patient information only once which not only saved time but also enabled the three team members to share the same information. This routine was followed more strictly during office hours; at other times, patient care was mostly performed freely, in the "old way".

Highest Competence First: Previously, a junior physician often had to consult the senior cardiologist to assess patient's medical situation accurately. This time consuming process could not be fixed in some trials and caused the 'flow group' to think differently. The new idea was to introduce the highest competence first in the assessment process. The presence of a senior cardiologist in the care team thus helped to remove waste (in Lean terms) from the preliminary assessment phase.

Morning Meetings: With the start of morning shift, each preliminary assessment team met in front of a whiteboard at the work station. This activity was aimed to use VM for the CI activity. The idea was to visualize and review the number of patients seen in the previous day and the percentage discharged in less than 4 hours. Furthermore, the problems faced in the care process were intended to be discussed and resolved. The first part, to review the performance in terms of achieving the 4 hours target worked well and continued for more than a year. However, the second part, to discuss the problems and finding ways to resolve them, worked only for a few weeks but then faded away. According to some participants, the reason was same to abandon both parts. The responsible physicians stopped to attend these meetings gradually and the meeting could not be continued.

4.1.3.4 After the Lean Intervention

During 2009 and early 2010, the Lean intervention was implemented and worked well. With the help of the Lean changes, the ED had achieved the goal to discharge 80 % of patients within 4 hours. The Cardiac ED was performing at about 90 %, the surgery and urology section were at about 80 % and the medicine and orthopedic sections were still missing the goal by a few points. A comparison of different performance indicators during 2008-2011 at the Cardiac ED are given in the Table 7. At the Cardiac ED, there were some concerns among the staff regarding the inclusion of physicians in the morning meetings. The new seating plan and team assessment model helped both physicians and nurses to work smoothly without unnecessary delays or waiting times and to reach decisions faster than before. The nurses saved time as they no longer had to search for the ECG machine. The four-hour ED length-of-stay target, the main objective of the change, was achieved by the Cardiac ED.

During 2010, perhaps due to a perception that the new plan was working well and that staff was sufficiently engaged, hospital management gradually reduced the time allocated for the flow group members' Lean work. At the same time, however, the Lean routines deteriorated gradually and the morning meetings were no longer held. The structural changes, e.g. the new workstation, were still there, but the procedural changes were abandoned. For instance, it became more difficult to include physicians in the new way of working. This coincided with a marked deterioration in the four-hour performance indicator. From the second half of 2010, the Cardiac ED was no longer achieving the goal to discharge 80 % patients within 4 hours and it decreased as low as 76 % during the year 2011. The new management at the ED appointed some Lean coaches again in different sections as an effort to revive Lean routines during the second half of 2011.

Table 7. Performance indicators with annual percentage change at the Cardiac ED

Year	2008	2009		2010		2011	
	(Baseline)	Average	Change	Average	Change	Average	Change
Monthly average of total number of patients	1010	1055	+4.46	1094	+3.70	1240	+13.35
Monthly average of percentage of patients discharged within 4 hours	74.00	83.17	+12.40	84.50	+1.60	76.54	-9.42
Monthly average length of stay (in minutes) of patients in the Cardiac ED	206	155	-24.8	129	-16.80	153	+18.60

4.2 STUDY IV

Given the importance of CI and possibly of VM tools in sustaining Lean through employees' engagement, study IV investigated how VM tools such as whiteboards may help to undertake Lean-inspired CI work in Ward-I and II. It was a single case study based on interviews, observations and photographs.

4.2.1 Continuous Improvement at Ward-I

At Ward-I, CI was started as a part of the Lean-inspired intervention under the name 'Lean meetings'. The idea was to improve the care process by engaging the whole staff through weekly meetings. The venue for the meetings was the staff coffee room (ubiquitous in Swedish work settings) which helped the staff to participate and remain updated about the change efforts. The weekly meeting was held on Wednesdays at 2.30 p.m. enabling the morning and the evening shift staff to participate in the meeting during the staff changeover period. Two whiteboards (a suggestion board and an action board) were used to help communicate the work visually to the whole staff.

The staff was encouraged to write any suggestion, anonymously or with their name, on the suggestion board any time during the week. Allowing the staff to write suggestions anonymously helped them to express their views more freely. Each suggestion was supposed to be on the board for at least two weeks before it was discussed in the meeting. During this time, all staff members had an opportunity to vote for or against it on the same board. During the meeting, the suggestion was selected for discussion if there were more votes for it than against it or if some staff member presented some

good reason to select it for discussion. As there were more nurses than physicians among the staff, this democratic method for accepting suggestions could have been problematic for some suggestions related to physicians' work. However, this seldom happened and was not an issue at Ward-I. Also, voting was not performed for suggested changes with important medical implications; instead, in these cases the physician in charge was consulted to reach a decision.

The selected suggestions were moved to the action board. An action plan was prepared to implement each approved suggestion using A3 paper forms which described the change, plan for testing the change for some days, implementation date, follow-up date and personnel responsible for the change. The follow-up was conducted on the scheduled date and the evaluation could result in one of three outputs: i) the change had gone well and should be adopted; ii) the change needed to be improved so a new action plan was made; or iii) the change was found unsuitable and abandoned.

Many respondents described that during the initial few months, the number of suggestions and changes was very high. Later, the number of suggestions decreased gradually as the most apparent problems were resolved. This new method of discussing the suggestions in the meetings after only two weeks was a faster and more democratic approach to change on the ward. Previously, suggestions were presented to the head nurse who subsequently discussed them with physicians during their meetings; decisions were made without the participation of other staff members.

The leadership at the ward was keen to keep the staff engaged in the change process. The respondents from the leadership expressed that using whiteboards in CI helped in this regard. Some staff members stated that CI and whiteboards empowered the staff members in the change process which helped them to remain engaged and interested in the Lean work.

4.2.2 Continuous Improvement at Ward-II

At Ward-II, like on Ward-I, CI was started as part of the Lean-inspired intervention. As noted in Study I above, however, the CI meetings – aimed to improve the care process through small changes – were combined with the daily morning meetings, aimed to plan the daily work. That meeting activity could not be sustained, probably due to the mixing of incompatible aims and difficulties with gathering the whole ward staff. Subsequently, parallel daily morning meetings were started in each section of the ward. Later on, an effort to restart CI meetings turned out to be very challenging due to the staff's previous negative experience of CI and their limited sense of any need for CI. Only a few times during the year did some of the staff use the whiteboards for planning, execution and follow-up of care process changes.

4.3 STUDY II AND III

Study II and III, focusing on socio-technical aspects of a Lean intervention, examined how Lean may be related to changes in group functioning (Study II) and the psychosocial work environment (Study III) over time. The settings were the same as in Study I.

4.3.1 Situation of Settings at T1 and T2

At T1 (the first survey data collection), Ward-I had already started its Lean implementation a few months earlier. The staff had received the Lean training, had applied 5S and VSM and had started working in teams. For about two months, they had been participating in weekly CI meetings. Between T1 and T2, Lean changes including CI work continued smoothly, as did the teamwork which was appreciated by the staff. Thus at T2, the Lean-inspired changes mentioned above were sustained and the staff was experiencing an overall positive impact of Lean changes.

On Ward-II at T1, the staff had received Lean training but didn't perceive it very suitable for them as health care personnel. The staff was also reluctant to make Lean changes because they felt they were already performing very well; they perceived the Lean changes as a burden. Despite this reluctance, the staff did implement Lean and had made some changes prior to T1 (see Study I). The introduction of CI did not work well (see Study I) and exacerbated the bad reputation of Lean at this ward. Furthermore, some contextual factors, unrelated to Lean, influenced the situation at the ward, including a high patient volume during the mid of 2010, a re-scheduling of working hours and decreased staffing on certain shifts following a budget cut and high staff turnover. The ward leadership was changed and efforts were started to revive Lean in the ward. Thus at T2, there was an atmosphere of Lean revival with a new leadership at Ward-II. The staff was neither enthusiastic nor skeptical about this revival but really looking forward to the actions of the new management.

The ED, at T1, had already implemented and worked with Lean changes for 14 months, since the first half of 2009. The Lean changes were working well with regular morning meetings but without CI work. The ED had achieved the goal to discharge 80 % of patients within 4 hours. Between T1 and T2, the removal of Lean coaches from their roles and a deterioration of Lean routines coincided with a marked decrease in the 4 hour target percentages. Efforts to revive Lean work had been started by the new ED management during the second half of 2011. Thus at T2, the ED was not performing very well; neither in terms of Lean work nor according to the performance indicators.

4.3.2 Documentation of Expected Outcome Patterns

For both Study II and III, in light of our understanding of the situation at T1 and T2 as outlined above, we documented expected change in each survey scale at each ward. The predictions were based on expected effects of Lean or of other, concurrent, changes at the respective setting as shown in Tables 8, 9, 10 and 11.

Table 8. Changes expected in GDQ subscales at three settings with motivations

	Scale (Stage)	Change		Motivation
		Num	*Impact*	
Ward-I	Inclusion & Safety (I)	0	unchanged	Already resolved and Lean intervention may not affect it
	Dependency (I)	0	-do-	-do-
	Lack of Structure (I)	–1	Improve	Lean structural changes may help to improve it
	Fight (II)	–1	Improve	Teamwork, CI and VM may help to improve it
	Negative Emotions (II)	0	unchanged	Already resolved and Lean intervention may not affect it
	Counter-dependence (II)	0	-do-	-do-
	Emerging Structure (II)	0	-do-	-do-
	Structure (III)	+1	Improve	Lean structural changes should improve it
	Trust/Cooperation (III)	+1	Improve	Lean as a whole should improve it
	Leader as a resource (III)	+1	Improve	Lean and supportive leadership may improve it
	Effective Organization (IV)	+1	Improve	Better structure after Lean, process improvement after CI
	Culture/Norms/Values (IV)	+1	Improve	CI and work redesign may improve it
	External Relations (IV)	+1	Improve	Not reached at this level yet
Ward-II	Inclusion & Safety (I)	0	unchanged	Already resolved and Lean intervention may not affect it
	Dependency (I)	+1	Decline	Feelings that change was decided by the top management
	Lack of Structure (I)	–1	Improve	Lean structural changes may help to improve
	Fight (II)	–1	-do-	High at T1 and may improve due to teamwork
	Negative Emotions (II)	–1	-do-	Very high at T1, may improve by new leadership rather than Lean
	Counter-dependence (II)	–1	-do-	-do-
	Emerging Structure (II)	0	unchanged	No Lean intervention part is expected to affect it
	Structure (III)	+1	Improve	Lean structural changes should improve it
	Trust/Cooperation (III)	0	unchanged	As Lean was not considered fruitful for the ward
	Leader as a resource (III)	0	-do-	Low at T1 and not much trust yet in leadership at T2
	Effective Organization (IV)	0	-do-	Lean without CI work is not enough to improve this scale
	Culture/Norms/Values (IV)	0	-do-	-do-
	External Relations (IV)	0	-do-	Not reached at this level yet
ED	Inclusion & Safety (I)	0	-do-	Already resolved, Lean deterioration may not change it
	Dependency (I)	+1	Decline	Expected to decline due to Lean deterioration
	Lack of Structure (I)	+1	-do-	As structure deteriorated and routines not followed properly
	Fight (II)	0	unchanged	As these issues are not expected to be resolved even at T2
	Negative Emotions (II)	0	-do-	-do-
	Counter-dependence (II)	+1	Decline	Deterioration of Lean, faith in leadership may worsen causing a decline in this scale
	Emerging Structure (II)	0	unchanged	No change expected as deterioration of structure may not show change in emerging structure
	Structure (III)	–1	Decline	As structure deteriorated and routines not followed properly
	Trust/Cooperation (III)	–1	Decline	Expected to decline due to Lean deterioration
	Leader as a resource (III)	0	unchanged	As the staff has not reached a stage to see the leader as an asset.
	Effective Organization (IV)	0	-do-	No change as the setting has not reached that level
	Culture/Norms/Values (IV)	–1	Decline	Expected to decline due to Lean deterioration
	External Relations (IV)	0	unchanged	Not reached at this level yet

Note. *Num* denotes numerical change for which *Impact* is different; reduction in Scales I & II scores and increase in Scales III & IV mean development in group function.

Table 9. Changes expected in COPSOQ scales for Ward-I with motivations

Scale	Change	Motivation
Quantitative Demands	–1	Better work design due to Lean intervention
Tempo	–1	-do-
Cognitive Demands	+1	CI work and use of VM
Emotional Demands	0	No related to Lean or some other change
Demands for Hiding Emotions	0	Not related to Lean intervention at Ward-I
Influence at Work	+1	Lean with CI activity
Possibilities for Development	+1	-do-
Meaning of Work	+1	Steady Lean intervention with CI
Commitment to Workplace	+1	-do-
Predictability	+1	CI with VM
Rewards at Work	+1	Lean with a supportive leadership
Role Clarity	+1	Improved work organization as a result of Lean
Role Conflicts	–1	Lean generally
Social support from Colleagues	+1	Teamwork, CI and new seating plan
Social support from Supervisors	+1	Supportive leadership
Social Community at Work	+1	Steady Lean having teamwork
Horizontal Trust	0	Already good enough at T1
Vertical Trust	0	-do-
Justice and Respect	+1	Physicians and nurses working in pairs may lead to feeling of fair work distribution

Table 10. Changes expected in COPSOQ scales for Ward-II with motivations

Scale	Change	Motivation
Quantitative Demands	–1	High value at T1 due to high patient volume and Lean work
Tempo	–1	-do-
Cognitive Demands	–1	CI and VM being tried at T1 but couldn't work
Emotional Demands	+1	Bad Lean perception increased dissatisfaction
Demands for Hiding Emotions	0	Not related to Lean intervention at Ward-II
Influence at Work	+1	VSM, work redesign and teamwork
Possibilities for Development	0	No CI activity
Meaning of Work	0	No CI activity mean no employee involvement
Commitment to Workplace	+1	High turnover implies very low value at T1
Predictability	0	Limited information dissemination as no VM
Rewards at Work	0	Not related to Lean intervention at Ward-II
Role Clarity	0	No CI to make roles clearer
Role Conflicts	0	No other changes to increase role conflicts
Social support from Colleagues	+1	Teamwork and new seating plan
Social support from Supervisors	+1	Staff welcomed leadership change before T2
Social Community at Work	+1	Teamwork and new seating plan
Horizontal Trust	0	The scale item regarding management will cancel the effect of teamwork
Vertical Trust	0	Distrust at T1due to Lean likely to be cancelled by trust in new leadership at T2
Justice and Respect	+1	Physicians and nurses working in pairs may lead to feeling of fair work distribution

Table 11. Changes expected in COPSOQ scales for ED with motivations

Scale	Change	Motivation
Quantitative Demands	+1	Deterioration of Lean
Tempo	+1	-do-
Cognitive Demands	–1	Morning meetings with whiteboard being held at T1 but abandoned till T2
Emotional Demands	0	Not related to Lean intervention at ED
Demands for Hiding Emotions	0	-do-
Influence at Work	0	Likely poor at T1 and remain poor at T2
Possibilities for Development	–1	Deterioration of Lean
Meaning of Work	–1	-do-
Commitment to Workplace	–1	-do-
Predictability	0	Not related to Lean intervention at ED
Rewards at Work	–1	Deterioration of Lean
Role Clarity	–1	-do-
Role Conflicts	+1	-do-
Social support from Colleagues	–1	Less teamwork as morning meetings abandoned
Social support from Supervisors	–1	Withering leadership
Social Community at Work	–1	Less teamwork
Horizontal Trust	0	No Lean or other changes likely to change this
Vertical Trust	–1	Deterioration of Lean
Justice and Respect	0	-do-

4.3.3 Description of the Sample

In Study II and III, all the nurses and nurse aides at the three settings were invited to participate in the survey study. As nurses were typically stationed at the same setting, whereas the physicians were rotating between settings, we preferred to include only nurses and nurse aides to get a more homogenous sample. Staff members on sick leave or parental leave were excluded. The characteristics of the sample in Studies II and III are presented in Table 12 and 13, respectively. For T1 in Study II, 133 participants (60% of the total) returned questionnaires, seven were discarded due to incomplete information; hence 126 were included in the analysis. For T2, 130 participants (63% of the total) returned questionnaires, eight were discarded due to incomplete information; 122 were included in the analysis. The demographic characteristics of the samples at T1 and T2 were not significantly different. However, at Ward-II, there were more nurses than nurse aides at T2 as compared to T1. For T1 in Study III, 129 participants (58% of the total) returned questionnaires, one was discarded due to incomplete information; 128 were included in the analysis.

Table 12. Characteristics of the sample for each setting in Study II

	Ward 1		Ward 2		ED		Overall	
Source	T1	T2	T1	T2	T1	T2	T1	T2
Response rate	72	68	63	54	56	65	60	63
Same respondents[a]		56		56		47		50
Women	82	75	93	92	83	84	86	84
Age								
Under 30	30	19	29	24	30	18	30	20
31-45	64	56	42	48	52	62	51	58
Over 45	6	25	29	28	18	20	19	22
Education								
School/College	12	6	23	32	49	40	37	34
University	82	94	77	68	51	60	63	66
Profession								
Nurse aid	41	25	35	44	52	40	47	38
Nurse	59	75	65	56	48	60	53	62
Experience								
< 5 year	88	81	48	64	55	48	58	56
5 – 20 years	12	13	39	24	37	47	34	38
> 20 years	0	6	13	12	8	5	8	6

Note. Values are expressed as a percentage of the total number of respondents.
[a]Values in this row are shown only for T2 as a percentage of respondents who responded at both T1 and T2 of the total number of respondents at T2.

Table 13. Characteristics of the sample for each setting in Study III

	Ward-I		ED		Ward-II		Overall	
Source	T1	T2	T1	T2	T1	T2	T1	T2
Response rate	68	64	56	64	59	54	58	62
Same respondents[a]		50		47		36		43
Women	82	63	84	83	94	92	86	81
Age								
Under 30	30	13	30	10	28	24	29	13
31-45	47	56	55	67	38	44	50	61
Over 45	23	31	15	23	34	32	21	26
Education								
School/College	35	13	55	34	28	24	46	30
University	65	87	45	66	72	76	54	70
Profession								
Nurse aid	41	31	59	40	41	44	52	40
Nurse	59	69	41	60	59	56	48	60
Experience								
< 5 year	88	75	54	46	47	60	57	52
5 – 20 years	12	13	39	51	41	24	36	41
> 20 years	0	12	7	3	13	16	7	7

Note. Values are expressed as a percentage of the total number of respondents.
[a]Values only shown for T2 as a percentage of respondents who responded at both T1 and T2 to the total number of respondents at T2.

For T2, 131participants (64% of the total) returned questionnaires, three were discarded due to incomplete information; 128 were included in the analysis. There were no significant differences in demographic characteristics of the samples at T1 and T2.

4.3.4 Study II Findings

In Study II, the comparison of GDQ scale scores for T1 and T2 (Table 14), shows that scores on Ward-I increased in Scale III and Scale IV, indicating that while the team was still within Stage III it had progressed towards Stage IV; on Ward-II scores decreased in Scale II and increased in Scale III indicating that the team had progressed within Stage II towards Stage III; and at the ED, there was a decline in all the four scales and respondents remained within Stage I.

Table 14. GDQ actual scale scores at T1 & T2 for each setting

Setting	Scale I	Scale II	Scale III	Scale IV	Stage
Ward-I					
T1	39	39	49	50	III[a]
T2	41	39	53	54	III[b]
Ward-II					
T1	42	46	47	49	II
T2	41	41	49	49	II
ED					
T1	43	41	49	51	I
T2	44	43	47	48	I

[a]Just entering into stage III.
[b]Well entered into stage III.

Table 15. Regression analysis results for GDQ and COPSOQ

Setting	GDQ			COPSOQ		
	Beta	F(1,10)	*p*	Beta	F(1,17)	*p*
Ward-I	.486	3.087	.11	.494	5.496	.03
Ward-II	.600	5.614	.04	.558	7.676	.01
ED	.644	7.098	.02	.507	5.881	.03

The changes found in the subscale scores for the three settings partly matched the expected ones; this match was mostly true for changes expected to be positive or negative but less true for the changes expected to be null(Figure 4). A regression analysis was performed to test this match statistically which was significant for Ward-II and the ED but not for Ward-I (Table 15). Hence, the actual changes partly mirrored the expected pattern. All in all, both the scale and subscale results show that Ward-I, which implemented Lean quite successfully during T1 and T2, exhibited improvements in group functioning; that Ward-II, where the Lean intervention was implemented partially also experienced slight improvements in group functioning (albeit at an earlier stage); and that in the ED, where the already implemented Lean intervention deteriorated, there was a decline in all aspects of group functioning. Despite that the ED was at Stage I when measured at T1, scale III score was high, which is unusual for teams at Stage I. A high score for scale III represents that a high energy is being spent

on production issues by a team. Hence, the changes found in GDQ subscales were in line with the fate of the Lean-inspired interventions in each setting.

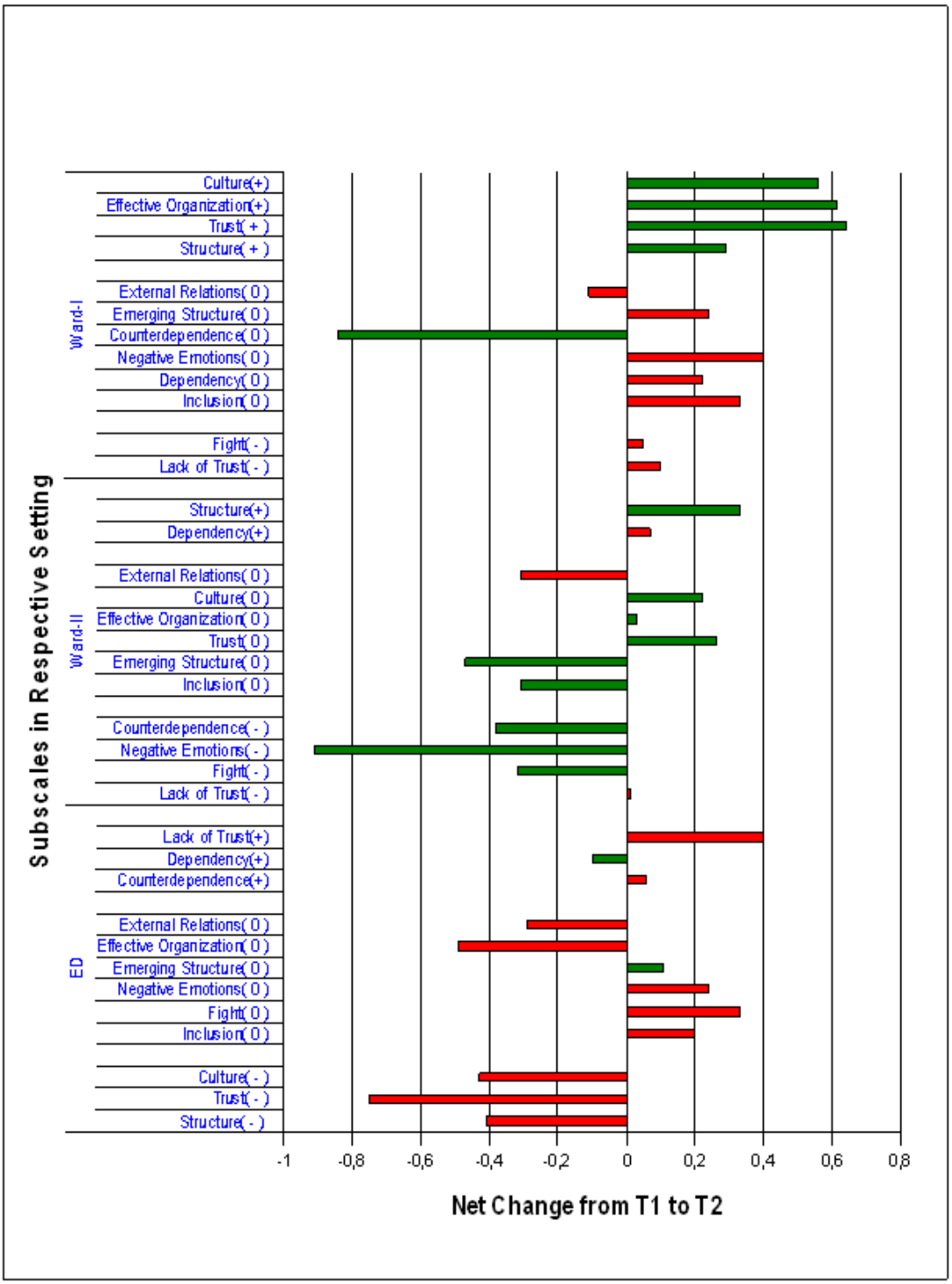

Figure 4. Actual changes in GDQ subscales at the three settings

Note. Green and red bars represent subscale changes leading towards positive and negative development in group functioning respectively. The sign in parenthesis immediately after the subscale name shows the direction of change in that subscale we had expected. The subscale names in each setting are in different order as they are grouped according to expected direction of change.

4.3.5 Study III Findings

In Study III, the regression analysis of expected versus actual changes in COPSOQ responses were statistically significant for all the three settings. (Table 16) Comparing the actual scales scores to the expected ones, 13 out of 19 actual changes were same as predicted at Ward-I. Similarly, ten out of 19 actual changes were same as predicted for both the ED and the Ward-II. For Ward-I, three scales 'Justice and respect', 'Role conflicts' and 'Tempo at work' changed in the opposite direction to what was expected. The scale 'Possibilities for development' was expected to increase but increased a little and fell in the category of 'null'. Out of four scales which were expected not to change, two scales ('Horizontal trust' and 'Vertical trust') decreased; the other two remained unchanged as expected. Both for Ward-II and the ED, almost half of the actual changes were same as predicted. The 'Quantitative demands' and 'Cognitive demands', which were among the scales deemed to be most responsive to Lean, changed as expected in all three settings. The 'Vertical Trust', which was also among the scales deemed to be most responsive to Lean, did not change as expected in any setting.

Considering only the domains we deemed as most responsive to Lean i.e. 'Work organization and job content' and 'Interpersonal relations and leadership', nine out of the eleven actual changes were same as predicted for Ward-I, eight out of the eleven actual changes were same as predicted for the ED, and four out of the eleven actual changes were same as predicted for Ward-II. Considering the results domain-wise for all the three settings collectively, actual changes were in the same direction as expected in nine out of 15 for 'Demands at Work', eleven out of 15 for 'Work organization and job content', ten out of 18 for 'Interpersonal relations and leadership' and only two out of nine for 'Values at the workplace'.

Ward-I and ED showed changes in *different* directions for 13 out of 19 scales while Ward-II and ED showed changes in *different* directions in 14 out of 19 scales. Ward-I and Ward-II showed changes in the *same* direction for 12 out of 19 scales. These figures are more prominent considering only the two domains, 'Work Organization and job content' and 'Interpersonal relations and leadership'. The patterns created by these figures for Ward-I & II are quite *similar* while the pattern for ED is *almost opposite* to the ones exhibited by Ward-I & II (Figure 6). There were eight scales which we deemed to be most responsive to Lean implementation before the analysis. The patterns of changes for only these scales showed the contrast between Ward-I & II and ED more prominently than the overall scale patterns. Focusing particularly on these scales, all the scales except the 'Vertical Trust' changed as expected for the ED and Ward-I; meanwhile, five out of eight scales changed as expected for Ward-II. The 'Vertical Trust' was the only scale which didn't change as expected for all the three settings. Based on these results, Figure 5 shows how the graphs for Ward-I and Ward-II are partly similar in pattern; however, the ED graph pattern is almost opposite in direction. With regards to the expected versus actual changes for these eight scales, most of the scales changed as expected. Only one scale ('Vertical trust') did not change as expected at any setting. Looking setting-wise at Ward-I and ED, all the scales changed as expected except 'Vertical trust'. For Ward-II, only four out of the eight scales changed as expected.

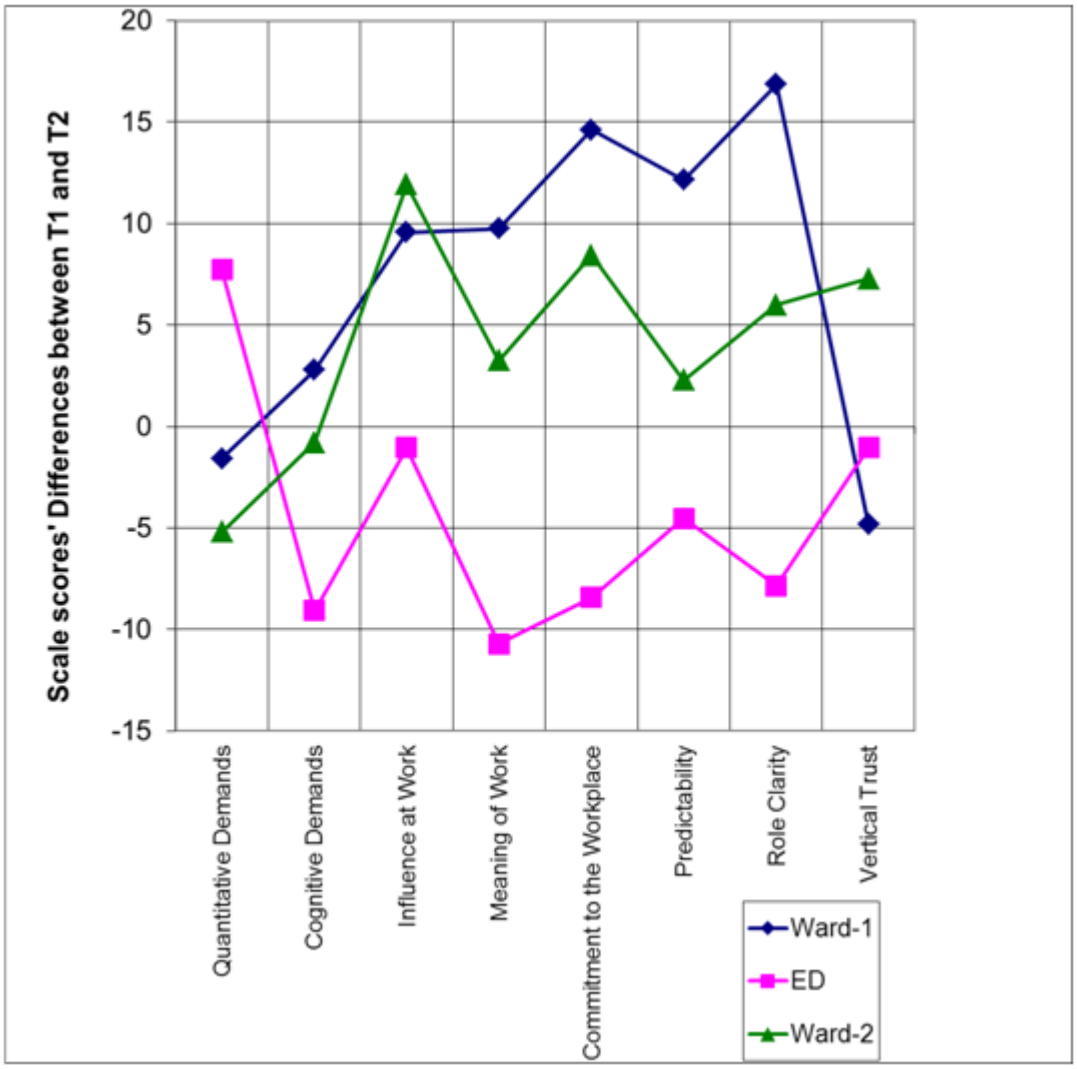

Figure 5. COPSOQ patterns for scales most responsive to Lean at three settings

Note (Table 16). Hyp = expected direction, Diff = Numerical difference between the T1 and T2 values of the relevant scale, n denotes the number of respondents in each setting at that time.

Table 16. COPSOQ scale scores in the three study settings at T1 and T2

Scale	ED				Ward-I				Ward-II			
	T1 (n =80)	T2 (n =87)	Diff	Hyp	T1 (n =17)	T2 (n =16)	Diff	Hyp	T1 (n=32)	T2 (n=25)	Diff	Hyp
Quantitative demands	44.9 (15.8)	52.6 (16.4)	+7.7	+1	38.2 (15.0)	36.7 (15.3)	–1.6	–1	45.7 (21.0)	40.5 (15.8)	–5.2	–1
Tempo at work	75.2 (13.4)	74.0 (15.8)	–1.2	+1	59.6 (13.6)	64.2 (18.8)	+4.6	–1	70.3 (18.7)	64.1 (12.9)	–6.3	–1
Cognitive demands	78.5 (12.4)	69.4 (18.7)	–9.1	–1	66.7 (16.4)	69.4 (14.3)	+2.8	+1	70.6 (13.0)	69.8 (18.4)	–0.8	–1
Emotional demands	52.4 (21.3)	60.1 (16.6)	+7.7	0	55.1 (23.0)	56.3 (22.8)	+1.1	0	50.0 (19.1)	55.0 (21.7)	+5.0	+1
Hiding emotions*	74.6 (13.0)	67.1 (16.5)	–7.5	0	71.1 (13.2)	70.6 (15.1)	–0.5	0	67.4 (12.6)	69.1 (14.8)	+1.6	0
Influence at work	39.6 (18.7)	38.5 (17.7)	–1.1	0	40.4 (13.6)	50.0 (20.4)	+9.6	+1	33.6 (16.3)	45.5 (18.4)	+11.9	+1
Possibilities for development	72.9 (22.9)	70.8 (18.5)	–2.1	–1	65.4 (15.6)	66.7 (20.4)	+1.2	+1	69.1 (14.5)	72.4 (18.4)	+3.3	0
Meaning of work	86.9 (15.2)	76.2 (16.5)	–10.7	–1	79.4 (13.2)	89.2 (10.4)	+9.8	+1	81.3 (13.5)	84.5 (11.6)	+3.3	0
Commitment to the workplace	69.5 (20.2)	61.0 (20.1)	–8.4	–1	59.6 (21.4)	74.2 (16.0)	+14.6	+1	51.6 (19.5)	60.0 (17.7)	+8.4	+1
Rewards at work	62.2 (18.7)	60.4 (15.5)	–1.7	0	58.8 (20.6)	75.9 (16.6)	+17.1	+1	60.2 (18.9)	66.7 (12.6)	+6.5	+1
Predictability*	57.0 (15.7)	52.4 (15.7)	–4.5	–1	53.7 (9.6)	65.8 (16.7)	+12.2	+1	49.2 (13.8)	51.5 (19.2)	+2.3	0
Role clarity	75.0 (14.7)	67.2 (15.9)	–7.8	–1	64.0 (9.8)	80.8 (10.4)	+16.9	+1	62.5 (15.9)	68.5 (14.5)	+6.0	0
Role conflicts*	48.7 (13.5)	52.2 (13.0)	+3.5	–1	41.9 (9.3)	46.3 (20.2)	+4.3	+1	48.8 (12.1)	54.1 (7.4)	+5.2	0
Social support from colleagues	80.6 (10.5)	80.8 (13.3)	+0.2	–1	73.1 (11.4)	79.3 (9.6)	+6.2	+1	76.5 (12.0)	74.2 (12.1)	–2.3	+1
Social support from supervisors	56.2 (29.7)	62.1 (23.2)	+5.9	–1	64.7 (22.6)	78.1 (16.8)	+13.4	+1	60.5 (21.3)	58.2 (20.2)	–2.4	+1
Social community at work*	82.2 (8.7)	79.5 (11.5)	–2.7	–1	77.3 (14.2)	85.3 (8.4)	+8.1	+1	80.2 (12.0)	81.9 (10.1)	+1.7	+1
Horizontal trust*	32.0 (14.8)	43.0 (15.9)	+11.0	0	29.9 (17.4)	26.1 (13.7)	–3.8	0	26.8 (14.2)	25.4 (14.2)	–1.4	0
Vertical trust	66.0 (17.0)	64.9 (18.0)	–1.0	–1	69.1 (12.6)	64.3 (21.3)	–4.8	0	56.3 (20.3)	63.5 (12.7)	+7.3	0
Justice and respect	55.4 (15.6)	57.9 (17.4)	+2.5	0	64.7 (14.1)	60.0 (18.4)	–4.7	+1	51.6 (15.5)	63.5 (14.2)	+12.0	+1

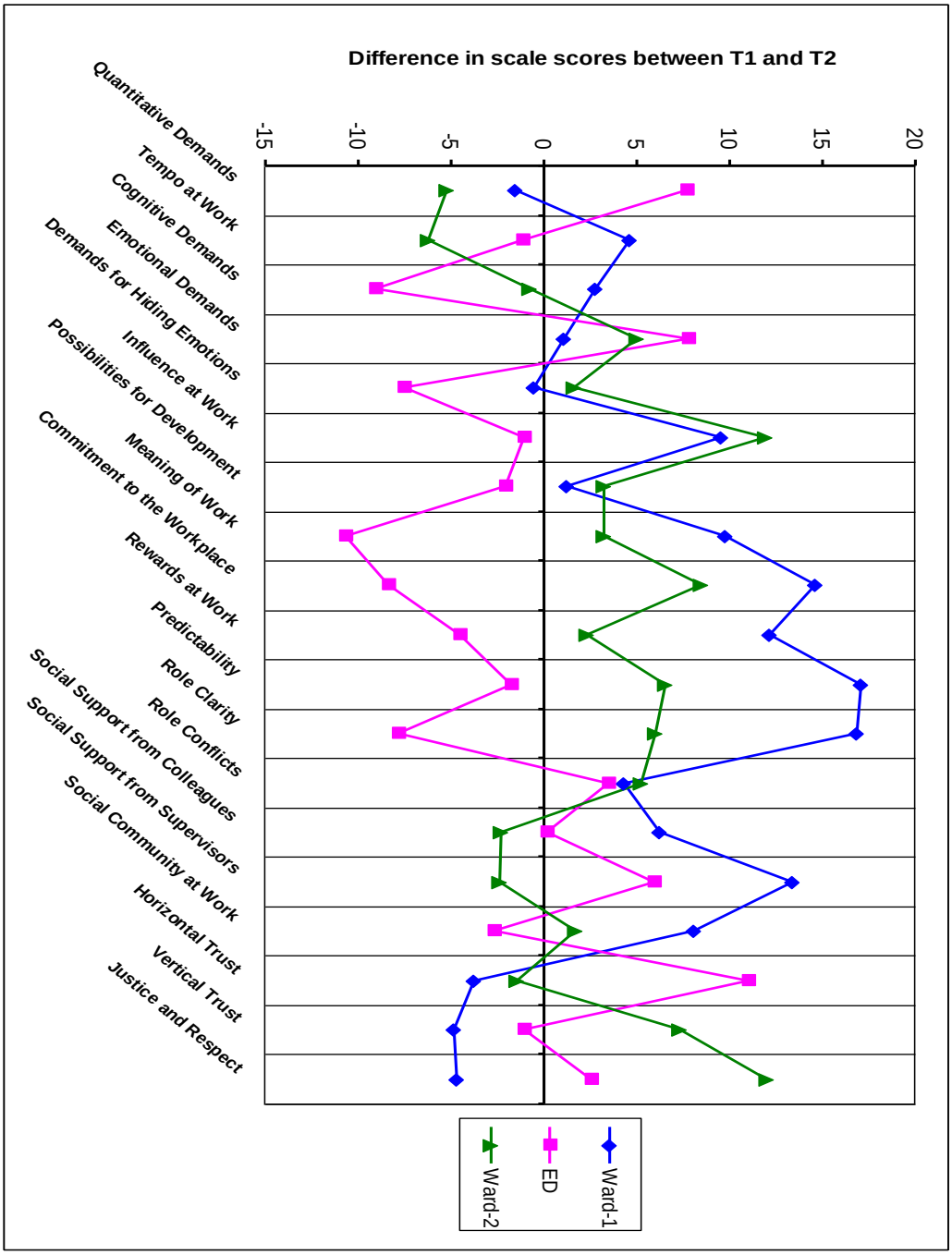

Figure 6. COPSOQ scale change patterns at three settings

4.4 SUMMARY OF MAIN FINDINGS

Study I found that previous improvement efforts at the Cardiology Department resulted in a clear structure, established core processes and active involvement of physicians in the care process which facilitated the adoption of Lean. Lean was implemented in the study setting to meet the increasing patient demands and improve efficiency. The results of Lean implementation were different at the study settings. Ward-I implemented and sustained Lean intervention with a supportive leadership and enthusiastically engaged staff in the Lean work and CI. Ward-II managed to implement Lean intervention only partially as the staff did not see a need to implement Lean. The

staff felt that they were already working well and any change initiative was a burden added to the routine work. In addition to this, Ward-II experienced an unexpected high patient volume, changes in work hour schedules, caused by a budget cut, and a high turnover after the beginning of Lean changes. The Lean intervention worked but CI could not be continued and abandoned. Lean intervention went well at the ED with work redesign, especially the preliminary review in teams led by specialists. After the initial success, Lean coaches were removed gradually which coincided with deterioration of Lean and the performance targets, achieved after Lean, were lost.

Study IV found that Ward-I with implementation of CI and VM, as a part of Lean intervention, was successful in engaging the employees in change work and sustaining Lean results. VM was found helpful in CI. Whiteboards, as VM tools, enhanced teamwork and improved decision making by enabling the inclusion of team members not participating in the meetings. Ward-II faced problems in CI implementation when it was mixed with the morning meetings resulting in a bad reputation to Lean-inspired CI among the staff. VM tools, such as whiteboards, worked well when adopted in line with the employees' way of working.

Study II found the predicted group development patterns significant for Ward-II and ED and not significant for Ward-I, when regressed with actual questionnaire survey data. The findings show that, at Ward-I, group functioning improved with a steady Lean implementation including CI. Group functioning at Ward-I was already at stage III when Lean was implemented with supportive leadership and engaged staff in Lean intervention. At Ward-II, group functioning struggled with relational issues with a partial Lean implementation. Ward-II was experiencing contextual issues including high patient volume, a budget cut and staff not happy with the increased work load due to Lean changes. At ED, group functioning was stuck at early stages with an initial success following a deterioration of Lean intervention.

Study III, using the analysis method similar to Study II, found the predicted psychosocial work environment patterns significant for all the settings. The change patterns found in the psychosocial work factors were in line with Lean intervention results. The pattern for Ward-I, with a steady Lean implementation was almost opposite to the pattern for ED, with the deterioration of an already well implemented Lean intervention. The pattern for Ward-II, with a partial Lean implementation was much similar to Ward-I pattern but opposite to the ED pattern. This matching between Ward-I and Ward-II and contrast between ED and the two wards was more prominent in the patterns made by the scales expected to be most responsive to Lean changes.

5 DISCUSSION

To address the main aim of the thesis in this chapter, I discuss how Lean-inspired improvement efforts might work in health care settings and how they might relate to employees in terms of teamwork and psychosocial work factors. Guided by Pettigrew and Whipp's model, I discuss the context, content and process, and outcomes of the Lean intervention in this thesis. This three-part organization allows me to highlight the findings and contributions of each part. This in turn may help practitioners design better Lean interventions in their health care settings and assist researchers in their investigations of Lean interventions.

5.1 CONTEXT

This section discusses the contextual factors found important regarding Lean intervention execution and sustainability in this thesis.

5.1.1 Employees' Willingness to Change

Young [14] suggests that the concept of value in health care should be examined by taking the health care employee perspective in addition to the patient perspective. Batalden and Davidoff [139] propose that a linkage exists between improved health care performance and the health care staff's professional development. The willingness of health care employees to change their way of working is important for the adoption of Lean.[58] The Ward-II employees were hesitant to change their way of working because they were already satisfied with their performance. Therefore, even before the implementation of the new way of working, they were negatively disposed towards the proposed Lean implementation. This attitude can be described as 'an indirect effect' of Lean on employees as outlined in Holden's Lean model.[1] Given this negative attitude, the Ward-II employees adopted parts of Lean, leaving other parts including the CI.

According to the change management[59,60] and Lean[7(p.10)] literature, managers need to gain the trust and commitment of employees before taking any change initiative. Although the staff at Ward-II received education and training, they did not think the training was very useful. Because of the training, which included industrial process exercises using LEGO® blocks, they concluded that Lean was an industrial management strategy that was inappropriate for their health care work.[64,65]
To succeed in the CI implementation along with other parts of the Lean intervention, the employees could have been motivated through Lean education and training focused on the fact that there is always room for improvement i.e. the essence of CI.[61] Yet the same Lean intervention at Ward-I, in the same department, worked well. Although the top management approach to the Lean intervention was the same in both wards, the contextual differences between the wards may, in part, account for the different outcomes. Ward-I was new and comparatively small, with a relatively young staff; Ward-II was older and larger than Ward-I, with a more experienced staff. Despite the same top management influence, the Lean initiative ended up with different results in the two wards. These contextual differences point to the importance of "bringing the employees on board" when implementing Lean.[7,17(p.98)] Managers and leaders, who are introducing a Lean intervention, can play an important role in motivating the staff and

justifying the Lean change. They can emphasize the possible benefits of Lean changes: improving the care and safety of patients and advancing the professional development of health care professionals.[139,140]

5.1.2 Adaptation of Lean in Health Care

Before the adoption of Lean, the Cardiology Department already had in place a structure with explicit core processes and the active involvement of physicians. This was the result of previous quality improvement efforts that might have facilitated the decision to adopt Lean.[70,71] Contrary to this, it may be speculated that a bad previous experience of improvement efforts might hinder the decision to adopt Lean. Further research is needed to clarify this relationship. However, as Ward-II, in the same department, was unable to sustain Lean, at least partially, the previous improvement efforts may have had little or no relevance in sustaining Lean results over time.

In Ward-I, supportive leadership was found helpful in the more successful Lean intervention at Ward-I, in line with previous studies.[40,74,141] Lean theory promotes management's involvement, as in Ward-I, in the problem-solving of CI work.[29,31] When the Lean coaches left the ED after a successful Lean implementation, routines deteriorated. This is an example of withering leadership, which is contrary to Lean theory[29] and that other health care studies warn against.[68,142]

5.1.3 Sustaining Lean in Health Care

The sustainability of Lean outcomes relates to the fit between the intervention and the context.[68] Ward-II and the ED were unable to preserve this fit in the long run. The withdrawal of the Lean coaches[29] and the decline in participation by the physicians[67] in the Lean work did not help sustain the Lean results. The reluctance of the employees to change their way of working,[7,59] the introduction of a morning meeting mixed with the CI for all staff from a large ward, and the employees' negative perception of Lean[50] reduced the likelihood that Ward-II could sustain the Lean results. In Study IV, a finding was that VM might work only if it matches with the staff's way of working. This finding supports the conclusion that a good fit between the intervention and the context is necessary for the execution and sustainability of a Lean intervention.[68]

In summary, context in terms of supportive leadership can either help making Lean intervention successful (Ward-I) or in terms of staff reluctant to change can hinder adopting some parts of Lean (Ward-II) or in terms of withering leadership can even contribute to deterioration of a Lean intervention already implemented (ED).

5.2 CONTENT AND PROCESS

5.2.1 Work Redesign

Holden[1] encourages researchers to study work structure and work process under Lean implementation. Study I reveals how the Lean intervention benefited changes in work design (i.e., in both work structure and work process). Moreover, Study I helps us understand how the changes in work design (i.e., in both work structure and work process) improve the process and change employees' daily work. This insight suggests

that Lean deals with changing the process as well as changing those unhelpful structures that support the process.[1] Patient care improved as a result of Lean-inspired changes in work design. In the ED, a quick increase and then a gradual decrease in the patient care indicators coincided with the Lean success and its gradual deterioration. At Ward-I and Ward-II, the participants thought that the modified sequence of reviewing patients in the mornings led to more efficient discharge of patients.[8]

5.2.2 Lean-inspired Teamwork

The staff at the three settings who worked in Lean teams (e.g., flow group at ED) and work teams (e.g., care teams at Ward-I &Ward-II) inspired by the Lean intervention[1] appeared to have better communication and coordination routines.[143] This finding is consistent with other research that shows a positive impact of Lean intervention on teamwork.[55,79,81] This finding reveals the effect of Lean-inspired teamwork on the overall teamwork of the health care staff. Further aspects of Lean and teamwork interactions are described in Section 5.3.1.

5.2.3 Continuous Improvement and 5S

The staff at Ward-I had a positive impression of the 5S activities as a good introduction to Lean. They were enthusiastic about taking part in the cleaning, sorting and ordering of the workplace. The 5S activities are intended to create an atmosphere conducive to improvement work by staff, [24] as was the case at Ward-I. For the CI work, the staff had management support to start the activity as found helpful in a previous study.[42] Ward-I staff autonomy in designing and executing the CI work according to their needs was in line with Lean theory.[42] In short, because 5S and CI were to a large extent implemented in accordance with Lean theory, they promoted the Lean work and its sustainability at Ward-I.

The staff at Ward-I was at Stage III in terms of teamwork which shows positive internal team dynamics. These dynamics helped them undertake CI work in line with previous findings.[17,42] All these factors favor the CI work in the long run which was the case at Ward-I. They were confident and happy about participating in the CI work. This participation helped sustain the work that mirrored the previous finding that CI helps engage staff[12,13,42] and sustain Lean changes.[37,118] Dennis[37] has identified this as one of the strengths of CI.

Perez[45] notes that CI work in Lean is often constrained by the pre-set objectives mainly related to the business process, whereas the work conditions and cognitive demands are neglected. The staff at Ward-II saw the CI work as a burden that only increased the work of patient care. The fact that they saw no benefit to them of the CI work suggests a lack of work environment advantages from the CI work. Although CI work could empower them and increase their work autonomy, the staff still felt these benefits were inadequate compensation for the increase in their work.[45]

5.2.4 Visual Management

Research has identified VM as a useful tool for engaging staff in CI work[47,144] as exemplified at Ward-I. As earlier studies show,[47,145] the use of VM boards (two

whiteboards in this research) can create a sense of ownership among staff. This was the case at Ward-I. The weekly meetings around the boards were helpful to enhance their use. The teamwork and communication between the staff was enhanced through the use of this VM tool.[47,146] The whiteboards used as VM tools helped the staff in several ways. The staff remained updated with the changes taking place under CI. As a communal memory tool, it helped to distribute the communication across time and space.[147] It enabled staff members, including those not present at the meetings, to participate in the CI work through the suggestion board.[148] At any time of day, they could write anonymous suggestions and got updated information about the changes being made which facilitated and enhanced teamwork among the staff. To express suggestions anonymously on the whiteboard helped staff members to make change suggestions freely and avoid any professional tensions as previous research has shown.[149] The whiteboards also promoted the CI work in that their use allowed multiple users to access information simultaneously.[146,149] Their location in the coffee room was convenient for information distribution and for discussion.[149] In short, VM tools such as whiteboards can enhance the CI work and in turn can help to execute and sustain Lean intervention. Hence, there is need to explore and understand the use of VM tools in relation to Lean in health care as this issue is understudied.[47]

5.3 OUTCOMES

5.3.1 Teamwork

Before I discuss the findings regarding the implications of Lean on teamwork, clarification is needed on the concept of teamwork under Lean as mentioned in the introduction section. Lean intervention is often implemented with teamwork as a part of it which I termed as 'Lean-inspired teamwork' in section 5.2.2. Two types of teams may be developed under it as outlined in the introduction section. I understood in this thesis work that health care teams are complex and difficult to study. Both the team members and their roles may change quite often. One way of studying health care teamwork is to assume the setting as one team and measure its group development over time. In Study II, I examined the overall effect of the Lean intervention on teamwork by considering the entire setting as a single team and by measuring its group development.

Study II demonstrates quantitative evidence of significant improvements in group development at Ward-I, a slight improvement at Ward-II, and decline in the ED. These findings are consistent with steady Lean implementation at Ward-I, partial Lean implementation at Ward-II and deterioration of previously implemented Lean in the ED. Group development at Ward-I was most evident in the GDQ scores for the three settings. Arrow *et al*[99] found that groups in the higher stages of group development are more responsive to external changes. At its higher stage, Ward-I's significant group development under Lean implementation agrees with Arrow *et al.'s* findings. Despite this development in terms of scale scores, the regression analysis between the expected and actual subscales scores was not statistically significant given the small sample size (n=25). This finding implies that the method used to analyze the interactions between Lean and group development should be tested in more studies with small and large sample sizes to check its appropriateness.

The case of ED was different from the other two settings because of the Lean deterioration at ED during the data collection period. Significantly, the ED showed a slight decline in all aspects of group development, as expected. The case analysis points towards the gradual removal of Lean coaches during this period. The withering leadership support has been suggested as a cause of deterioration in teamwork.[5] At ED, the group development was stuck at Stage I, even with the Lean success. One explanation could be that external interventions (e.g., Lean) may cause the groups to remain stuck in a particular stage.[99] However, the ED team, despite its struggles at Stage I, showed a high score for scale IV, which was unusual. This finding reveals that a lot of energy was spent on productivity, perhaps reflecting the urgency of the work in such a setting. This finding may also be explained by the nature of ED teams. Such teams are typically characterized by stable roles with varying personnel,[95] which emphasizes structural and productivity issues more than relational issues.[99] Finally, this finding also shows that the relationship between Lean and teamwork may also depend on team type.

Factors other than Lean might also have influenced the group development, positively or negatively, in the three settings. Ward-I had favorable contextual factors for Lean, particularly its supportive leadership, the enthusiasm of its young staff, the entire staff's willingness to make changes, and the high level of group functioning (Stage III) at T1. These contextual factors might also have improved the group functioning between T1 and T2. By contrast, Ward-II struggled with Stage II at T1 and the contextual factors (in particular, the staff reluctance to embrace change and the high staff turnover) did not favor the Lean intervention. These factors may also have damaged the possibility of achieving improvements in group functioning. The deterioration in Lean in the ED between T1 and T2 and the low level of group functioning at T1 (Stage I) might have impaired the group functioning. This finding highlights the challenge of studying the implications of Lean on teamwork in real life settings. Combining the case study methodology with other methods (as in Study II) may help us identify and measure the interactions between Lean and its outcomes.[104]

The findings in Study II suggest that it may be difficult for groups struggling with initial stages of group functioning to implement Lean smoothly. The group members' relational issues seem to be less responsive to Lean changes than the structural and productivity issues of teamwork. The preoccupation of group members with fight and dependency issues (in the initial stages) may make them less able to respond to Lean changes in terms of group development. This finding agrees with the previous finding that groups are less responsive to external changes in their initial stages.[99]

Overall, Lean seems to have some effect on teamwork, as shown by the changes in the Lean implementation in the settings of Study II. This relationship may differ depending upon the type of team as exemplified in the ED teams, and upon the functioning of the team when Lean is implemented, as per our findings that groups functioning in later stages of group development may mesh better with Lean changes. The question about causality remains elusive, however. There are two problems with establishing a causal relationship. First, there is the problem of separating the influence of Lean from the influence of other concurrent factors. Second, there is no valid measurement method or tool available to measure level of Lean implementation. If we can measure Lean as well

as teamwork simultaneously in a longitudinal design, the changes found in Lean and teamwork may allow us to identify some causal relationships. Future studies may try to find a comprehensive method to measure the level of Lean implementation. Moreover, identification of the team types and measurement of the level of group functioning before the Lean implementation begins may help integrate these factors with the analysis.

5.3.2 Psychosocial Work Environment

Employees' involvement in the Lean implementation may help minimize negative effects of Lean changes on their work environments.[1,104,119] Ward-I, with a supportive leadership, employee engagement and regular morning meetings, showed improvements in the domains 'Work organization and job content' and 'Interpersonal relations and leadership'. This finding is in line with earlier research that reaches similar conclusions, including reduced employee stress.[107,119] Conversely, in the same domains, the ED showed deterioration in its withering leadership, decreased employee engagement and infrequent morning meetings. The failure of CI at Ward-II might have damaged staff's social relationships[42] as shown by the deterioration in the 'Role Conflicts' and 'Social Support' scales. 'Vertical Trust' was a scale predicted to be most responsive to Lean implementation. However, the score changes on this scale did not support this prediction. The scale value decreased at Ward-I despite the steady implementation of Lean. It appears that the scale is more responsive to changes in management than in Lean implementation. For example, the scale value increased at Ward-II which might be related to the change of ward managers (welcomed by the staff) before the T2 measurement. Study III suggests that Lean, as it was implemented at Ward-I, had a positive impact on the psychosocial work environment. On the other hand, as was observable in the teamwork, the psychosocial work environment may deteriorate if Lean work declines after an initially relatively successful implementation. Such was the case in the ED.

Following Hasle's suggestion,[104] as described in section 1.5, we used qualitative data to acquire in-depth information about the context and intervention and to articulate the expectations which we statistically compared with the actual results. Rather than a search for a causal relationship, positive or negative, between Lean and the work environment, this method allowed us to identify and analyze the footprints of Lean in the work environment. This footprint was derived from explanations of changes in the work environment as the result of Lean or other, concurrent changes. Using linear regression, we matched our predictions with the observed changes in a statistically significant manner at the three settings. This method may be useful for further inspection of changes in COPSOQ scales (used in this study) in Lean implementations. The predictions at Ward-I matched the actual values more closely than in the other two settings. This finding points towards the possibility of obtaining better results of these predictions from a "cleaner" Lean implementation without many contextual problems such as existed at Ward-I.

Better team dynamics may be helpful in improving the work environment[100-102] and may, in turn, facilitate implementation of Lean. Conversely, a successful Lean intervention may result in a better work environment that may then lead to improved

teamwork. We don't know if Lean affects teamwork directly or through work environment and if Lean affects the work environment directly or through teamwork. These relationships may be opposite too where Lean may be affected by teamwork and work environment. The four studies of this thesis only show that the case study approach to in-depth information about a Lean intervention can predict, with some confidence, possible changes in teamwork and in the work environment. Further studies are needed to examine this issue in detail.

5.4 METHODOLOGICAL CONSIDERATIONS

This section presents some reflections on how the research methods used in this thesis contributed to the quality of the research. I found the case study approach useful in investigating issues regarding a Lean intervention in the real world, as Yin recommends.[124] For example, the case study approach led to an understanding of the background, implementation and implications of the Lean intervention as well as the context and changes other than Lean. Thus, I could understand, interpret and explain the outcomes of the Lean intervention (e.g., the reluctance of the Ward-II staff to accept the Lean intervention as described in Study I). In Study II and Study III, the case study approach elicited data that led to a clear articulation of the expected quantitative outcomes.

Surveys, which can be used with case studies, are often used for research in health care.[150] Mixed method designs have increasingly attracted the attention of researchers.[151] This methodology allows researchers to collect stronger evidence and to address more complex issues in research.[124,152] Yin[124] describes two nested arrangements for mixing case studies with surveys – a case study within a survey or a survey within a case study. A 'survey within a case study' refers to a case study of a clinic as the main data, and a survey of the clients within the clinic to complement the case study data.[127] In Study II and Study III, the case study data were used to create expected questionnaire results that were then compared with the actual results to achieve triangulation. Therefore, this study design may be considered an example of 'a survey within a case study'. Using this method in these studies helped to trace the footprint of Lean on teamwork and work environment. This helped to address the aim of the studies to see the implication of Lean for these two phenomena. Although this is not a standard method, I found this method helpful in studying relations between Lean and outcomes.

The drawback of using a case study methodology is that it is very difficult to establish causal relationships between the intervention and outcomes. In an attempt to overcome this limitation, I combined the qualitative and quantitative data in Study II and III. The 'survey within a case study' design in Study II and Study III increased the internal validity.[124] By combining the qualitative and quantitative data, I attempted to strengthen the evidence of interactions between Lean and teamwork as well as with the work environment. Yin[124] describes the 'pattern matching' analytic technique as a way to compare an empirically based pattern with a predicted pattern (before data collection). The comparison in these studies, between predicted and empirical patterns for quantitative measures, resembles the 'pattern matching' with the exception that we did

the prediction after T1 data collection in the longitudinal study design. The knowledge of T1 measurements was necessary to predict changes between T1 and T2.

The quality of qualitative research is assessed through construct validity, internal validity, external validity and reliability.[124] These terms are borrowed from quantitative research methodology.[131] Despite some attempts to develop alternative criteria and terminology for qualitative research assessments, these terms are still used frequently.[131] Construct validity refers to the level of agreement between the measures chosen and the concepts studied. Internal validity refers to the ability of a study to establish cause-effect links. External validity refers to how well a study's findings can be generalized to other situations. Reliability refers to how well the study's procedures are described so that, if replicated, they would produce similar findings.

The use of multiple data sources (data triangulation) and multiple methods (method triangulation) strengthened the construct validity through the convergence of evidence.[124] Interviews, observation and various document data were triangulated to complement each other. For example, the observations of CI meetings in the wards increased the understanding of the significance of the information acquired in interviews about the CI meetings. The case studies and survey questionnaires were used for method triangulation. Construct validity was also strengthened by maintaining the chain of evidence in the case studies.[124] This was accomplished by citing the original sources of data in the case interpretations and by indicating the circumstances under which the data were collected. Construct validity was further enhanced by the use of the longitudinal design. In this design, the Lean intervention was followed for several years with key informants invited to review and refine the case study.[124]

In Studies I and IV, explanation building was used to enhance the internal validity. Efforts were made to explain the case inferences by analysis of the data collected. All four studies addressed rival explanations to further enhance the internal validity.[124] This enhancement was accomplished by focusing on collecting Lean data and data on changes other than Lean. To address the external validity, I attempted to reach analytic generalizations in the studies.[124] Using Pettigrew and Whipp's model and Holden's model as guides, I conducted a case study that contributes to some theoretical propositions on Lean changes in health care. The case study protocol is a way to increase the reliability of the case study research.[124] The interview guide provided the basic questions and limited the interviews to the scope of the research questions. The interviews were audio-recorded. The observations were recorded as case notes to avoid researcher's recall bias, hence increasing the reliability of the data. The chronological order of data collection, with exhaustive details of data collection and analysis procedures, was presented to further enhance the reliability of the studies.[124]

One challenge in this research was the difficulty encountered in differentiating between the effects of Lean and other changes. In Study I, for example, in the enhanced staff utilization, the ED benefited from the employment of a heart coordinator and from the change in a junior ED physician position from part-time to full-time. Were these consequences of Lean or of some other change? My assumption was that these changes were Lean changes because they were taken during the Lean work. However, the Cardiac Department's budget cut, on the other hand, was a change other than Lean.

Were the outcomes, I found in the studies, were really due to Lean and some other changes which I mentioned? Rather than searching for cause-effect relationships, I tried to track these changes using qualitative data that I integrated with the analysis.

Another challenge in this research is that 'Was it really Lean that I studied'? In my opinion, the Lean-inspired efforts, that I studied, were mostly on the operational level to eliminate some waste but not on the strategic level to understand, and continuously enhance, the value.[6,153] This conclusion suggests that the findings in this thesis on Lean may be more applicable at the operational level where tool-based Lean is used.

The findings of this research, although limited to one case studied at only one hospital, are generalizable to theory as even a single case when reported by reference to other literature allows for generalization.[124,154] It is hard to determine the level of generalizability of these findings but it seems feasible to say that these findings may be used in hospitals similar to Danderyd hospital or in broad sense in a health care system similar to Sweden. It is difficult to say that these findings would be equally usable for non-health care organizations and or in the low-resource countries or in the countries having circumstances significantly different from Sweden. Possible users of these findings are warranted to study the Lean intervention and outcomes in the light of context in this thesis and then carefully design the Lean intervention considering their own context.

As a researcher collecting, most of the data used in this thesis, my perception about Lean and health care is important to describe as it may have enabled or even restricted the learning reported here. I had studied Lean theory and observed VM at Scania during my education at Royal Institute of Technology (KTH) in Stockholm. With a perception of Lean in industry, where it is relatively more established, it was easy to observe the differences in Lean intervention between industry and health care. Health care sector was new for me as I have an engineering background. It was an overwork to understand the organizational system and processes along with the intervention observation. But the strength was that I had rather fresh eyes to look into process and to analyze it.

5.5 FUTURE RESEARCH

In this section I identify some areas that merit further research. Intrinsic to all these areas is the question: 'How is Lean best implemented in health care settings?' I investigated the implications of Lean for health care staff group development and their work environment. Given the importance of the employees when Lean interventions are made in health care settings, more studies with rigorous study designs are needed to investigate the role and contribution of employees. The studies in this thesis were conducted in a few settings at one hospital. Future studies might take as their setting hospital-wide or even cross-hospital-wide contexts in the examination of Lean in health care. The survey study findings in this thesis are limited to nurses. Future survey studies might include other health care professionals, such as physicians, in the analysis to present more representative findings of the health care staff. Finally, the studies in this thesis examined the implications of Lean for health care staff only. Future studies might investigate the implications of Lean for patients to help designing better Lean interventions including also the patient perspective.

6 CONCLUSIONS

Lean as a management strategy in health care has the potential to improve the care process performance and to produce an improved work environment for health care staff. The adoption and sustainability of a Lean intervention can be affected by a mismatch between the intervention and its context. Lean-inspired continuous improvement work and visual management may help to keep health care staff engaged in the Lean work hence sustaining Lean practices in the long run. A Lean intervention has a greater potential to succeed and be sustained when it is introduced to the staff members working at more advanced stages of group development and being involved in the change process. Conversely, those staff members who work at the early stages of the group functions are likely to have greater difficulty in adopting and sustaining Lean.

6.1 PRACTICE IMPLICATIONS

Health care managers and practitioners who are preparing to implement Lean in their organizations may benefit from the following comments and recommendations:

- Staff members' perception of Lean, their willingness to change their way of working, and their involvement in the change process are very important factors for the adoption and sustainability of Lean in health care settings.
- Staff members should be empowered to conduct continuous improvement activities. Visual management, which is essential and helpful for engaging staff members in the change process, can facilitate these activities.
- It may be very challenging to implement Lean with staff functioning at the initial stages of group development.
- Managers' support and continuous involvement in a Lean change process may be crucial to its success.

SAMMANFATTNING PÅ SVENSKA

Bakgrund: I takt med att hälso- och sjukvården behöver möta ökande krav med begränsade resurser har Lean Management blivit alltmer populärt. Det finns mer kunskap om de operativa aspekterna av tillämpningen av Lean än om de socio-tekniska aspekterna såsom hur Lean hänger samman med teamarbete och den psykosociala arbetsmiljön. Det är också oklart varför och hur organisationer introducerar Lean.

Syfte: Detta projekt med fyra delstudier syftar till att identifiera förutsättningar och utmärkande drag för införandet av Lean på ett svenskt sjukhus. I studierna undersöktes också longitudinella förändringar av vissa socio-tekniska aspekter av Lean; teamarbetet och den psykosociala arbetsmiljön.

Metoder: I avhandlingen används en fallstudiedesign (med data från intervjuer, observationer och dokument) för att undersöka införandet av Lean på två kardiologiska avdelningar och en akutvårdsavdelning på ett svenskt sjukhus (studie I och IV). Under införandet av Lean mättes teamarbetet och den psykosociala arbetsmiljön vid två tidpunkter (T1 och T2) via medarbetarenkäter med ett och ett halvt års mellanrum. För att undvika efterkonstruktioner användes kvalitativa data om interventionen för att förutsäga förväntade förändringsmönster i teamarbetet och den psykosociala arbetsmiljön från T1 till T2. Dessa förutsägelser jämfördes med enkätdata med hjälp av linjär regressionsanalys (Studie II och III).

Resultat: Tidigare kvalitetsarbete vid sjukhuset lade grunden för införandet av Lean. Kontextuella faktorer tycktes påverka både implementeringen av Lean och dess hållbarhet över tid. Tillämpningen av Lean varierade exempelvis med i vilken utsträckning personalen såg ett behov av förändring. När visuell vägledning tillämpades framgångsrikt i det kontinuerliga förbättringsarbete, höll det personalen involverad och engagerad. Medarbetarnas delaktighet i införandet av Lean kan minimera förändringarnas skadliga effekter på den psykosociala arbetsmiljön. Lean kan påverka teamarbete, särskilt när det gäller frågor kring struktur och produktivitet.

Slutsatser: Ett framgångsrikt införande av Lean beror på anpassningen till kontextuella faktorer. Förutom traditionellt Lean-fokus på operativa prestanda är medarbetarperspektivet också viktigt för att utforma, införa och upprätthålla ett Lean-tänkande. Att engagera medarbetare i Lean-insatser hjälper inte bara för att nå framgång initialt utan bidrar också till att undvika skadliga effekter av Lean på arbetsmiljön. Initial Lean-framgång kan bibehållas genom att engagerar medarbetarna i förändringsarbetet med hjälp av ständiga förbättringar med stöd av visuell vägledning. I det praktiska arebetet, bör man notera att, för grupper som befinner sig i inledningsskedet av gruppsamverkan, kan införandet av Lean utgöra en betydande utmaning.

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In February, 1984, I was walking in a street in my hometown in Pakistan with my elder brother. I noticed a nameplate outside a home with the owner's name and the letters 'PhD'. I had not seen those letters before. Curiously, I asked my brother, "What is a PhD"? He tried to explain to his younger brother, only 8 years old, in a very simple way: "The knowledge we acquire at schools and colleges is created by some highly educated people called PhDs". I was fascinated with the concept and thought, "How sophisticated people those PhDs must be"? That was 'the very moment' when I promised myself, "I will become a PhD". Although it has taken me 30 years to fulfill my promise, I am happy that, at last, I did it. I want to thank all those people who supported me, in any way, during this long journey. I would like to start by thanking my elder brother, Aqeel Ahmed, for introducing me to the concept of research.

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APPENDIX I: INTERVIEW GUIDE (STUDY I)

1. First of all, can you please tell me about you, your designation, job nature, professional experience and time spent with this organization?

2. What kind of quality improvement efforts you had (if any) before Lean?

3. What kind of lean strategy you are using, are you following any certain set of principles or have developed your own to implement?

4. What was the motive behind this idea to implement lean work?

5. When was it started and who took initiative?

6. Was everybody at the unit informed and convinced by the top management to do this?

7. What changes have been undertaken in the context of Lean work in your unit?

8. To what extent the changes have been implemented - use new ways of working all the time by all the employees or is it just certain times, or suits certain cases, or a few employees?

9. How and, in your opinion up to what extent, the staff has been involved to implement these changes?

10. How and, in your opinion up to what extent, the Lean changes have affected staff's daily work?

11. What modifications of approaches have been made during the process?

12. What effects have you noticed by the changes in terms of

    a. the process such as waiting times, efficiency, trouble etc.
    b. the workplace e.g. space, access to equipment etc,
    c. the team collaboration among the staff
    d. the work environment for the staff

13. Are there any measurements or other data that shows this?

14. How have you been using visual design of the work so far?

15. What are the lessons learned, in your opinion, about Lean implementation at your workplace?

APPENDIX II: INTERVIEW GUIDE (STUDY IV)

1. First of all, can you please tell me about you, your designation, job nature, professional experience and time spent with this organization?

2. Was continuous improvement planned to be implemented at your workplace as a part of Lean intervention?

3. What was the motive behind this idea to start continuous improvement?

4. When was it started and who took part in the planning?

5. Was everybody at the unit informed and convinced by the management to make these changes?

6. How did you plan to undertake continuous improvement activity?

7. Up to what extent the plan was implemented?

8. Did you use visual management to enhance the continuous improvement?

9. What visual management tool was selected and how it was used?

10. How and, in your opinion up to what extent, the staff has been involved to implement these changes?

11. How and, in your opinion up to what extent, visual management helped to undertake continuous improvement activities?

12. What were the factors, in your opinion, facilitating or hindering this change?

13. What effects have you noticed by the changes in terms of

    a. the process such as waiting times, efficiency, trouble etc.
    b. the workplace e.g. space, access to equipment etc,
    c. the team collaboration among the staff
    d. the work stress level of working people

14. Are there any measurements or other data that shows this?

15. What are the lessons learned, in your opinion, about Lean implementation at your workplace?

APPENDIX III: COPSOQ INSTRUMENT (STUDY III)

Stockholm University	Karolinska Institutet	DANDERYDS SJUKHUS

Undersökning av “Lean” och arbetsstress vid Danderyds sjukhus

i samarbete med
Karolinska institutet och
Stressforskningsinstitutet, Stockholms universitet

Copenhagen Psychosocial Questionnaire (COPSOQ)

Frågeformuläret COPSOQ II är utvecklat av Kristensen, T. et al., 2004. Det Nationale Forskningscenter for Arbejdsmiljø (www.arbejdsmiljoforskning.dk). Svensk version: Pousette, A. 2010. Arbets- och miljömedicin, Sahlgrenska akademin, Göteborgs universitet. Baseras på den svenska översättargruppens arbete med COPSOQ I, 2003: Arvidsson. M, Johansson, C., Kolstrup, C. & Pousette, A., samt kompletterande översättning av COPSOQ II, 2005: Ektor-Andersen, J. och Ørbæk, P.

Instruktioner

Frågorna i detta formulär handlar och hälsa, välmående och arbetsmiljö. Formuläret handlar om **dina** förhållanden och **din** åsikt och du ska därför undvika ”hjälp” från andra. Det finns inga rätta eller felaktiga svar. Det är viktigt för studiens kvalitet att du besvarar alla frågor, men om någon fråga inte är relevant för dig hoppar du bara över den.

Det tar 15-20 minuter att fylla i formuläret och du kan när som helst avbryta och fortsätta vid ett senare tillfälle. Om du vill ge mer detaljerade svar eller lägga till några kommentarer så finns det utrymme i slutet av formuläret. Du besvarar frågorna genom att markera det alternativ som är bäst med ett X. I vissa frågor är du ombedd att skriva några siffror eller några ord.

Naturligtvis är ditt deltagande helt frivilligt. Dina svar kommer att behandlas i statistisk form av forskarna och inte att vara tillgängliga för någon vid sjukhuset. Alla svar behandlas med den sekretess som tillämpliga lagar kräver och medger.

Om du har några frågor i samband med ifyllandet av formuläret eller om studien i allmänhet så är du välkommen att ringa oss på Medical Management Centre, Karolinska Institutet.

Vänliga hälsningar

Waqar ul Hassan
Doktorand
MMC, Karolinska institutet
08-524 837 30

Hugo Westerlund
fil.dr., docent
Stressforskningsinstitutet
Stockholms universitet
08-5537 8926

Bakgrundsfrågor

i. Är du

☐ 1 Man
☐ 2 Kvinna

ii Vilket år är du född _____

iii. Högsta utbildning

☐ 1 Grundskola
☐ 2 Gymnasium
☐ 3 Unversitetsutbildning mindre än 3 år
☐ 4 Universitetsutbildning, 3 år
☐ 5 Universitetsutbildning over 3 år
☐ 6 Disputerad

iv. Anställningstid på sjukhuset

☐ 1 Mindre än 6 månader
☐ 2 6 till 11 månader
☐ 3 1 till 2 år
☐ 4 3 till 7 år
☐ 5 8 till 12 år
☐ 6 13 till 20 år
☐ 7 21 år eller mer

v. Yrke

☐ 1 Undersköterska
☐ 2 Sjuksköterska
☐ 3 Läkare
☐ 4 Annat; vad? _____

1. Hur tycker du att din hälsa är i allmänhet?

☐ 1 Mycket bra
☐ 2 Ganska bra
☐ 3 Varken bra eller dålig
☐ 4 Ganska dålig
☐ 5 Mycket dålig

2. Hur många timmar per vecka är din ordinarie arbetstid (exkl. övertid)?

└__┘__ timmar per vecka

Hur många timmar per vecka arbetar du <u>i verkligheten</u> inklusive övertid och extraknäck?

└__┘__ timmar per vecka

3. Har du varit utsatt för skvaller eller förtal på din arbetsplats under de senaste 12 månaderna?

☐ 1 Ja, dagligen
☐ 2 Ja, varje vecka
☐ 3 Ja, varje månad
☐ 4 Ja, någon/några gånger
☐ 5 Nej

Om ja, från vem? (Du kan kryssa i mer än ett alternativ)

☐ 1 Kolleger
☐ 2 Chefer/överordnade
☐ 3 Underställda
☐ 4 Klienter/kunder/patienter

4. Har du varit indragen i bråk eller konflikter på din arbetsplats under de senaste 12 månaderna?

☐ 1 Ja, dagligen
☐ 2 Ja, varje vecka
☐ 3 Ja, varje månad
☐ 4 Ja, någon/några gånger
☐ 5 Nej

Om ja, från vem? (Du kan kryssa i mer än ett alternativ)

☐ 1 Kolleger
☐ 2 Chefer/överordnade
☐ 3 Underställda
☐ 4 Klienter/kunder/patienter

Hur ofta under <u>de senaste fyra veckorna</u> har du…	Alltid	Ofta	Ibland	Sällan	Aldrig
5. … sovit dåligt eller oroligt?					
6. … haft svårt att somna?					
7. … vaknat för tidigt och inte kunnat somna om?					
8. … vaknat upp flera gånger och haft svårt att somna om?					
9. … haft problem med koncentrationen?					
10. … varit lättirriterad?					
11. … haft svårt att tänka klart?					

12. … haft svårt att fatta beslut?					
13. …varit jäktad?					
14. … haft minnessvårigheter?					

	Alltid	Ofta	Ibland	Sällan	Aldrig
15. Hur ofta är din närmaste chef beredd att lyssna på dina problem med arbetsuppgifterna?					
16. Hur ofta får du hjälp och stöd från din närmaste chef?					
17. Måste du överblicka många saker samtidigt i ditt arbete?					
18. Försätter ditt arbete dig i känslomässigt svåra situationer?					
19. Har du stort inflytande över beslut som gäller ditt arbete?					
20. Kräver ditt arbete att du är initiativrik?					
21. Måste du ta ställning till andra människors personliga problem som en del av ditt arbete?					
22. Kommer du efter i ditt arbete?					
23. Innebär ditt arbete att du måste behandla alla lika, även när du inte känner för det?					
24. Kräver ditt arbete att du fattar svåra beslut?					
25. Har du tillräckligt med tid för att utföra dina arbetsuppgifter?					
26. Kan du påverka din arbetsmängd?					
27. Kräver ditt arbete att du ska komma ihåg mycket?					

	Alltid	Ofta	Ibland	Sällan	Aldrig/ nästan aldrig	Inte aktuellt
28. Hur ofta får du hjälp och stöd från dina arbetskamrater?						

29. Hur ofta är dina arbetskamrater beredda att lyssna till dina problem med arbetsuppgifterna?						
30. Är stämningen bra mellan dig och dina arbetskamrater?						
31. Är samarbetet bra mellan arbetskamraterna på din arbetsplats?						
32. Känner du dig delaktig i gemenskapen på din arbetsplats?						

	I väldigt hög grad	I hög grad	I viss mån	Ganska lite	Nästa inte alls
33. Hur nöjd är du med ditt arbete som helhet, allt inräknat?					
34. Är det nödvändigt att du arbetar väldigt snabbt?					
35. Kräver ditt arbete att du är initiativrik?					
36. Är dina arbetsuppgifter meningsfulla?					
37. Får du information i god tid på din arbetsplats t.ex. när det gäller viktiga beslut, förändringar och framtidsplaner?					
38. Finns det klara mål för ditt arbete?					
39. Ställs det motstridiga krav på dig i ditt arbete?					
40. Blir din arbetsinsats respekterad och uppskattad av arbetsledningen?					
41. Kräver ditt arbete att du döljer dina känslor?					
	I väldigt hög grad	I hög grad	I viss mån	Ganska lite	Nästa inte alls
42. Känner du att du gör en viktig arbetsinsats?					
43. Skulle du rekommendera en god vän att söka anställning på din arbetsplats?					

44. Är du bekymrad för att bli överflödig på grund av ny teknik?					
45. Får du veta allt du behöver för att klara ditt arbete på ett bra sätt?					
46. Gör du saker i arbetet som accepteras av vissa personer men inte av andra?					
47. Behandlas du rättvist på arbetsplatsen?					
48. Måste du vara vänlig och tillmötesgående gentemot alla oavsett hur de bemöter dig?					
49. Vet du precis vad som förväntas av dig i ditt arbete?					
50. Måste du ibland göra något, som egentligen borde ha gjorts annorlunda?					
51. Har du möjlighet att lära dig något nytt genom ditt arbete?					
52. Måste du ibland göra saker i ditt arbete, som kan verka onödiga för dig?					
53. Är arbetstempot högt under hela arbetsdagen?					
54. Upplever du att din arbetsplats har stor personlig betydelse för dig?					
55. Litar ledningen på att medarbetarna gör ett bra jobb?					
56. Kan man lita på vad som sägs från ledningen?					
57. Löses konflikter på ett rättvist sätt?					
58. Döljer de anställda viktig information för varandra?					
59. Döljer de anställda viktig information för ledningen?					
60. Litar de anställda i allmänhet på varandra?					
61. Fördelas arbetsuppgifterna på ett rättvist sätt?					

I vilket utsträckning anser din närmaste chef…	I väldigt hög grad	I hög grad	I viss mån	Ganska lite	Nästa inte alls
62. prioriterar trivseln på arbetsplatsen högt?					
63. är bra på att planera arbetet?					

Vill du få information om vår studie via e-post:

☐ 1 Ja, jag skulle vilja ha resultaten per e-post
☐ 2 Nej tack

Om du har några kommentarer rörande ditt arbete, så kan du skriva dem här:

_____

_____

_____

_____

_____

_____

Har du fler kommentarer om arbete och hälsa – eller om frågeformuläret?
V.g. skriv här:

_____

_____

_____

_____

_____

_____

Tack för din medverkan!